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## THREE NEW HARPACTICOID COPEPODS FROM THE SANTA MARIA BASIN OFF THE CALIFORNIAN PACIFIC COAST (COPEPODA, HARPACTICOIDA)

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### ABSTRACT

Three new harpacticoid copepods from the Santa Maria Basin off the south-central Californian coast are described: *Zosime pacifica* n. sp., *Cletodes macrura* n. sp. *Cletodes tuberculatus* n. sp. The three species are the most dominant harpacticoids found during a sampling program studying the possible effects of oil and gas developments in this area. The description of the copepodids of each species is included and a key to the species of the genus *Cletodus* is given.

### INTRODUCTION

In 1986 a sampling program began on the outer continental shelf in the Santa Maria Basin off the south-central coast of California, U.S.A. This is a pristine environment which is currently subject to future oil and gas development. The purpose of the sampling program was to determine if there were long-term impacts due to materials discharged during platform development and production (Hyland *et al.*, 1990).

One aspect of the multidisciplinary program is to determine if there are reproductive or life history effects on harpacticoid copepod communities. Harpacticoids are usually more sensitive to hydrocarbon exposure than the dominant nematodes (Fricke *et al.*, 1981; Bodin and Boucher, 1983; Hennig *et al.*, 1983). During the course of this study we found over 100 species (Montagna, in preparation), most of them new to science.

Three of the species were chosen for detailed life history analyses, and these are also new. These species were the dominant harpacticoids in the community (Montagna, in preparation). The details of the population dynamics are published elsewhere (Webb and Montagna, in preparation). The purpose of this paper is to describe these three new species.

### MATERIALS AND METHODS

The copepods described below were gathered during eight cruises to the Santa Maria Basin, off the Californian coast, between November 1986 and May 1989. Exact localities and sampling methods are described in detail in Hyland *et al.*, 1990. Most of the specimens of the herein described copepod species are used for detailed life history analyses but a representative sample of them is preserved as type material and deposited in the collections of the Zoölogisch

Museum Amsterdam (ZMA Coll. no. Co.), the Invertebrate collection of the Koninklijk Belgisch Instituut voor Natuurwetenschappen (Brussels: COP) and in the reference collection of Dr. P. Montagna (M.S.I, Port Aransas).

Dissected specimens are mounted in lactic phenol and the preserved ones are stored in 75% ethanol. Drawings were made with the aid of a camera lucida on a microscope equipped with phase contrast. Terminology and abbreviations are used according to Lang (1965), and setal formulae of the copepodids are listed following the method of Humes and Ho (1969).

#### ACKNOWLEDGEMENTS

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#### SYSTEMATIC DESCRIPTIONS

Family Tisbidae Stebbing 1910

Genus *Zosime* Boeck, 1872

*Zosime pacifica* n. sp.

Type-region. — Pacific Ocean, Santa Maria Basin, California (U.S.A.) between Punta San Luis and Purisma Point, at a depth ranging from 50 to 565 m.

Type-material. — Holotype: one dissected female, mounted on three slides from station PJ 23-2 (ZMA coll. no. Co.102.855); allotype: one dissected male, mounted on three slides from station PJ 7-1: (ZMA Coll. no. Co. 102.856); paratypes: dissected, 5 females (ZMA Coll. no. Co.102.857, COP 3113-3116; 1 male (ZMA Coll. no. Co.102.858); 2 Cop I (COP 3117-3118); 3 Cop II (COP 3119-3121); 1 Cop III (COP 3122); 2 Cop IV, females (COP 3123-3124); 1 Cop IV, male (COP 3177); 3 Cop V (males, COP 3125-3127); preserved: 27 females, 9 males, 15 Cop I, 10 Cop II, 1 Cop III, 10 Cop IV, 16 Cop V (females), 4 Cop V (males) (ZMA Coll. nom 102.859 — 102.862 and COP 3128-3137, M.S.I.).

Etymology. — The specific name refers to the Pacific Ocean, type area of the present species.

#### Description.

##### Adults

Female: habitus (Fig. 1a, b) fusiform compressed in dorsal view. Length, including rostrum and furcal rami, 420  $\mu$ m. Largest width near the posterior edge of the cephalothorax and the second thoracic segment (160  $\mu$ m). Cephalothorax large, almost one third of the entire body length, smoothly bending anteriorly in dorsal view. Lateral margins of thoracic segments bending smoothly posteriorly. Body constricted at the anterior margin of the first genital segment. Genital segments and second abdominal segment with posteriorly directed lateral extensions. Penultimate and anal segments with slightly rounded lateral margins.

Integumental structures. Entire surface of cephalothorax and pleurotergites covered with an irregular pattern of minute spinules (not illustrated). Posterior margin of cephalothorax smooth dorsally. Posterolateral margins and posteroventral edge of cephalothorax, as well as the thoracic pleurotergites furnished with irregularly formed blunt extensions (Fig. 1 e, d). Ventral and anterolateral margins of cephalothorax smooth. Median region of poste-

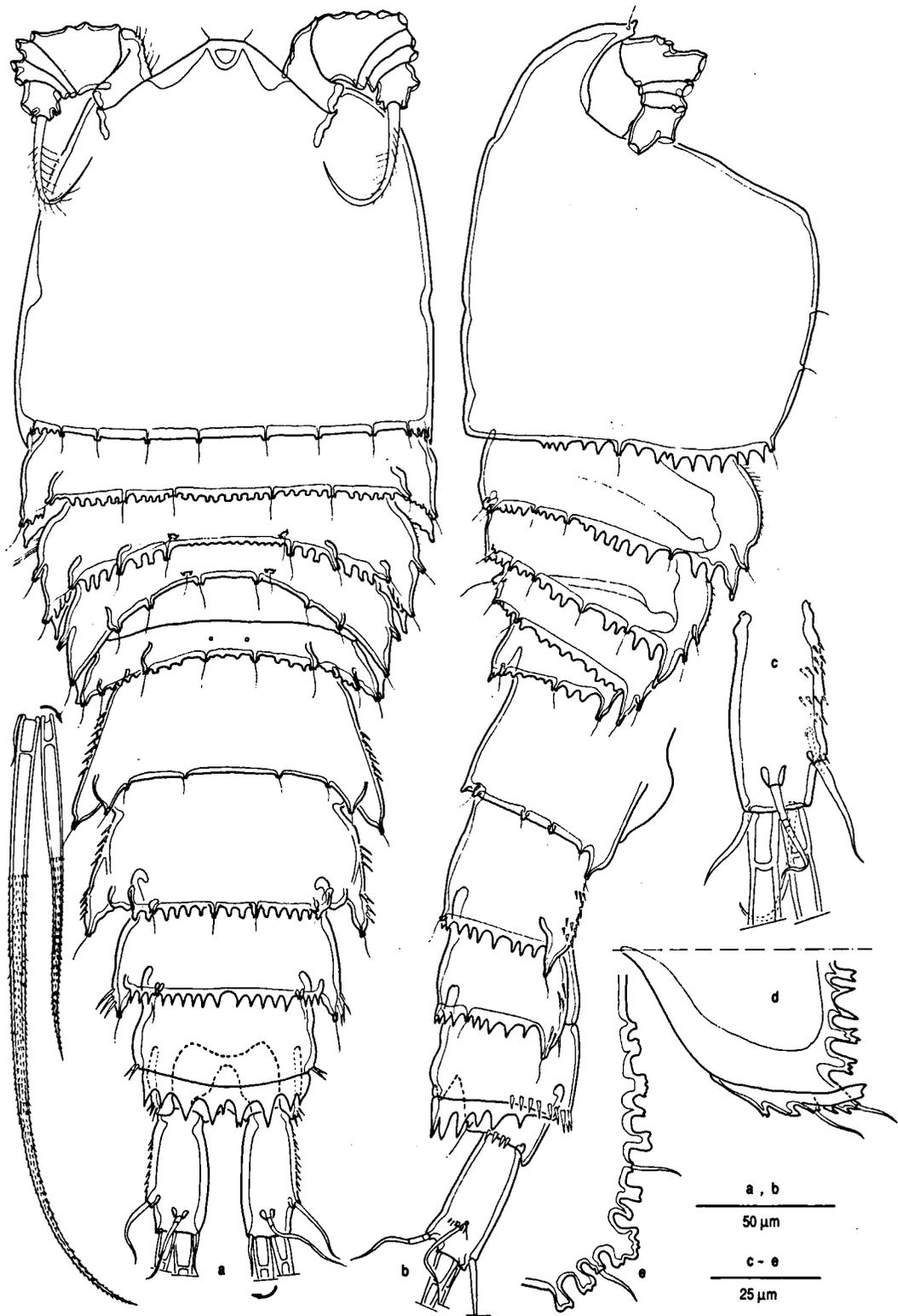


Fig. 1. *Zosime pacifica* n. sp., female: a, habitus, dorsal; b, habitus, lateral; c, right furcal ramus, dorsal; d, pleural region of third pleurotergite; e, posteroventral edge of cephalothorax.

rior margin of third and fourth thoracic segments with distinctly smaller and more rounded extensions. Posterior margin of first genital segment smooth, of the second one and abdominal ones set with sharper lips. Ventral surface of genital and abdominal segments smooth; posteroventral margin of second genital and second abdominal segments showing a wide hyaline frill, minutely incised. Posterior margin of third abdominal segment with, dorsally, a large hyaline frill, incised, covering the entire anal segment and, ventrally, set with long and slender spinules.

Genital field situated close to the posteroventral margin of the first genital segment; clasping organ convex and bearing two long setae on each side.

Furcal rami (Fig. 1c) with nearly parallel margins and about twice as long as wide ( $45\ \mu\text{m} \times 21\ \mu\text{m}$ ). Lateral and dorsal setae implanted in the distal fourth, the latter on a small socle and articulating on two basal parts. Ventral seta implanted close to the distal margin. Inner apical seta small, less than half the length of the ramus. Outer and inner apical setae robust, the former about half as long as the latter. Both set with a dense pattern of small spinules around the stem. Surface of the rami spinulose. Outer margin with a few transversal rows of distinctly longer spinules.

Rostrum (Fig. 2a) strongly tapering anteriorly. Rostral tip ventrally directed and strongly sclerotized. Rostral tip slightly protruding.

Antennule (Fig. 2b) six-segmented. First segment, bearing a single seta, set with strong spinules along the anterior margin. Aesthetascs implanted on the fourth ( $85\ \mu$  long) and sixth ( $39\ \mu\text{m}$  long) segments. All setae setulose or spinulose, except for some small setae on the penultimate and ultimate segments.

Antenna (Fig. 2 c, d) with large coxa. Basis cylindrical, bearing a seta along the inner side and a three-segmented exopodite. Surface of the basis having an oblique row of long and slender spinules. Exopodite articulating with the basis near the distal outer edge of the latter. Endopodite two-segmented. Proximal segment with a single, armed seta. Distal endopodal seg-

ment with three lateral setae (two of them strongly armed) and six distal ones. First and second exopodal segments with one seta, third exopodal segment small, about half as long as the preceding one, and third segment nearly twice as long as the first one.

Mandible (Fig. 2 e) having a robust and strongly sclerotized gnathobasis. Biting edge with four rigid teeth, one seta and some spinules. Mandible palp with distinctly one-segmented exopodite and endopodite, bearing three and four feathered setae respectively. Basis bearing three feathered setae, apically.

Prae-coxa of maxillule (Fig. 2 f) large and triangular. Arthrite with two slender lateral setae and with eight strongly armed spines arising from distal margin. Coxa bearing two epipodal setae and four inner setae. Basis bearing six setae implanted on the inner extension. Exopodite and endopodite present, cylindrical and bearing three and six setae respectively.

Maxilla (Fig. 2 h) having three endites. Proximal endite V-shaped, each branch bearing three setae. Median and distal endites cylindrical having three distal setae each. Basis hook-shaped, bearing a robust armed setae along with four slender and smooth ones. Two of the latter arising close to the articulation with the exopodite. Exopodal segment cylindrical, bearing five setae: three apical and two lateral ones.

Maxilliped (Fig. 2 g) with a triangular coxa, having a tuft of slender spinules. Basis slightly protruded having a robust armed spine and some small spinules. Endopodite one-segmented, furnished with two apical feathered setae and two smooth lateral ones.

Prae-coxa and coxa of P1 (Fig. 3 a) furnished with rows of long spinules as in the other legs. Basis with an outer and an inner armed seta, both reaching beyond the first segments of the rami. Exopodite three-segmented, endopodite two-segmented. Exopodal and endopodal spines set with much longer spinules along one side of the stem. Inner setae of the rami setulose. Chaetotaxy of P1 in Table 1.

P2 — P4 (Fig. 3 b, c, d, respectively) with rows of long spinules on protopodite surfaces.



Fig. 2. *Zosime pacifica* n. sp., female: a, rostrum, ventral; b, antennule; c, antenna; d, exopodite of the antenna; e, mandible; f, maxillule; g, maxilliped; h, maxilla; i, P5; j, abdomen, ventral.

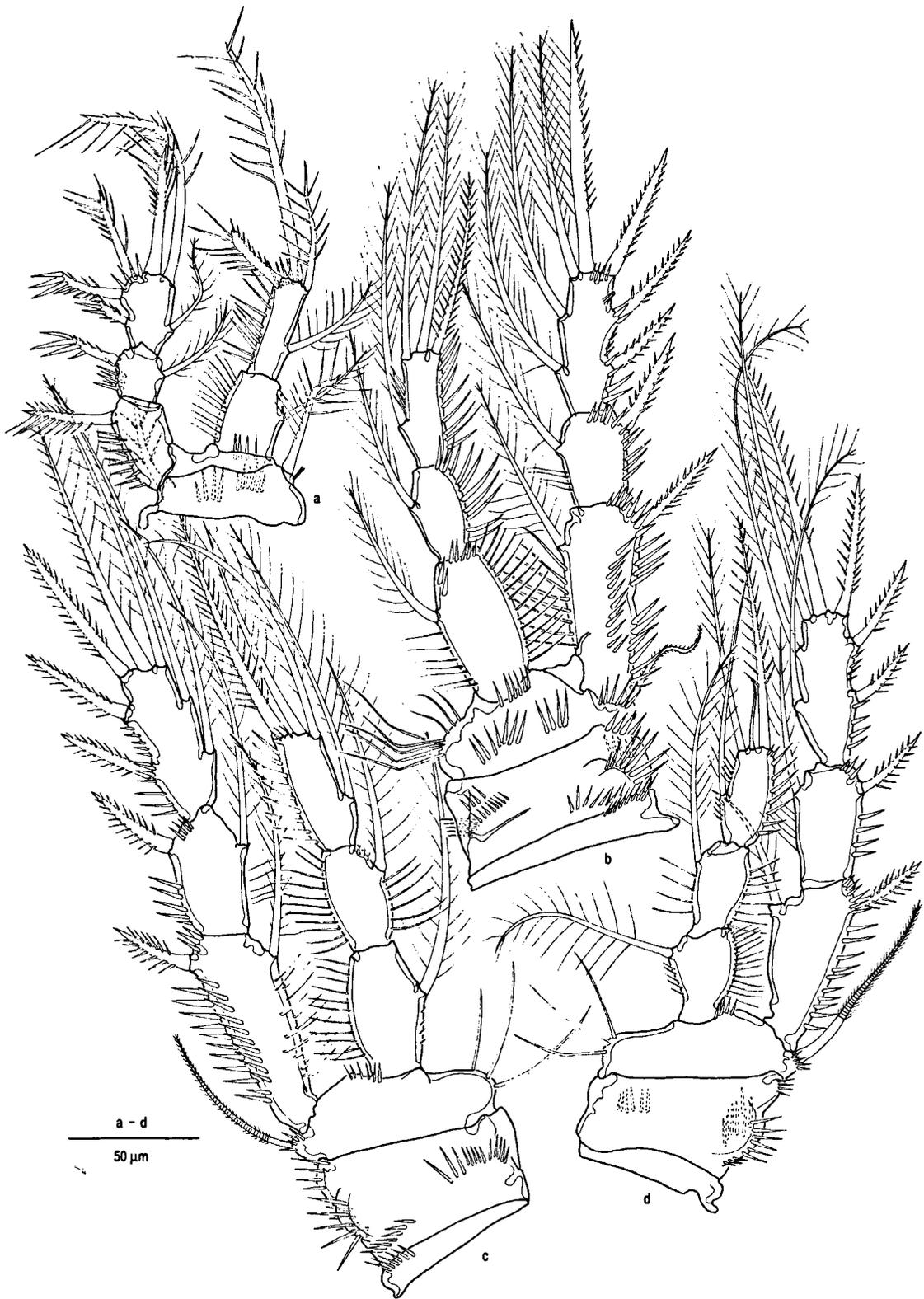


Fig. 3. *Zosime pacifica* n. sp., female: a, P1; b, P2; c, P3; d, P4.

Table I: Chaetotaxy of *Zosime pacifica* n. sp.

	P1	P2	P3	P4	P5♀	P5♂
exo	0-1-123	1-1-123	1-1-223	1-1-223	4	3
end	1-121	1-1-121	1-1-121	1-1-121	2 + 1	2 + 1

Outer seta of the basis striated and set with minute setules. Exopodites and endopodites three-segmented. Outer exopodal and endopodal spines symmetrically armed. Endopodites reaching towards the middle of the third exopodal segments of P2 and P3 and just beyond the articulation between the second and third exopodal segment in P4. All setae with a normal setulose appearance except for the dwarfed and smooth outer distal seta of the third endopodal segment of P4. Chaetotaxy of the legs in Table I.

P5 (Fig. 2 i) exopodite fused with baseoendopodite, bearing three and two setae respectively. Outer baseoendopodal seta implanted on a long cylindrical extension. One small seta, implanted on a small elevation, arising near the outer proximal edge of the exopodal lobe.

Male: habitus (Fig. 4 a) resembling the female but showing a more slender fifth thoracic and abdomen. Ventrolateral margins of the sixth segment strongly extended laterally.

Antennule (Fig. 4 b) sub-chirocer, seven-segmented. First segment with rigid spinules. Aesthetasc implanted on the fifth segment, distinctly wider than that of the female and about 95 µm long. Penultimate and ultimate segment each with a blunt conical process. Apex of ultimate segment extended, forming a straight and sharp claw.

Mouthparts and natatorial legs as in the female except for a distal endopodal segment of P2 bearing only one apical seta and an apical, curved, smooth hook-shaped process (Fig. 4 c).

P5 (Fig. 4 d) fused with the supporting segment and with chaetotaxy as in the female but bearing considerably smaller setae; endopodal lobe not protruded, exopodite articulating and less large than in the female.

P6 (Fig. 4 e) symmetrical. Both sides dis-

tinctly protruded and bearing two long spinulose setae and an inner dwarfed smooth one.

## Copepodids

### Copepodid I

Habitus (Fig. 5 a, d) fusiform compressed in dorsal view. Body composed of five somites. Lateral margins of the cephalothorax nearly parallel. Length, including rostrum and furcal rami, 225 µm. Cephalothorax almost half as the entire body length. Second and fourth thoracic segments with rounded lateral margins, third thoracic segment with parallel margins. Anal segment with a convex anal operculum. Posterior margins of all the somites smooth. Ventral surface and posterolateral edges of the anal segment with long spinules (Fig. 5 c).

Rostrum triangular, steeply bending anteriorly. Rostral tip rigid and straight.

Furcal rami twice as long as wide. Two lateral setae and dorsal seta implanted near the middle, one lateral seta arising from the distal outer edge and one seta implanted on the ventral surface. Principal setae fused over a short distance. Outer principal one armed with long spinules but striated near the tip. Inner principal seta set with minute spinules over the entire length.

Antennule (Fig. 5 h) three-segmented, bearing an aesthetasc on the second and third segments. All setae spinulose except for some slender ones on the ultimate segment.

Antenna as in the adult but less sclerotized. Exopodal setae smaller and less strongly armed (Fig. 5 f). Mandible, maxillule, maxilla and maxilliped as in the adult.

P1 (Fig. 5 b) and P2 (Fig. 5 g) protopodites with distinct prae-coxa, coxa and basis, all furnished with spinules. Bases with an outer spine. P1 without inner spine on the basis. Rami one-segmented. Chaetotaxy in Table II.

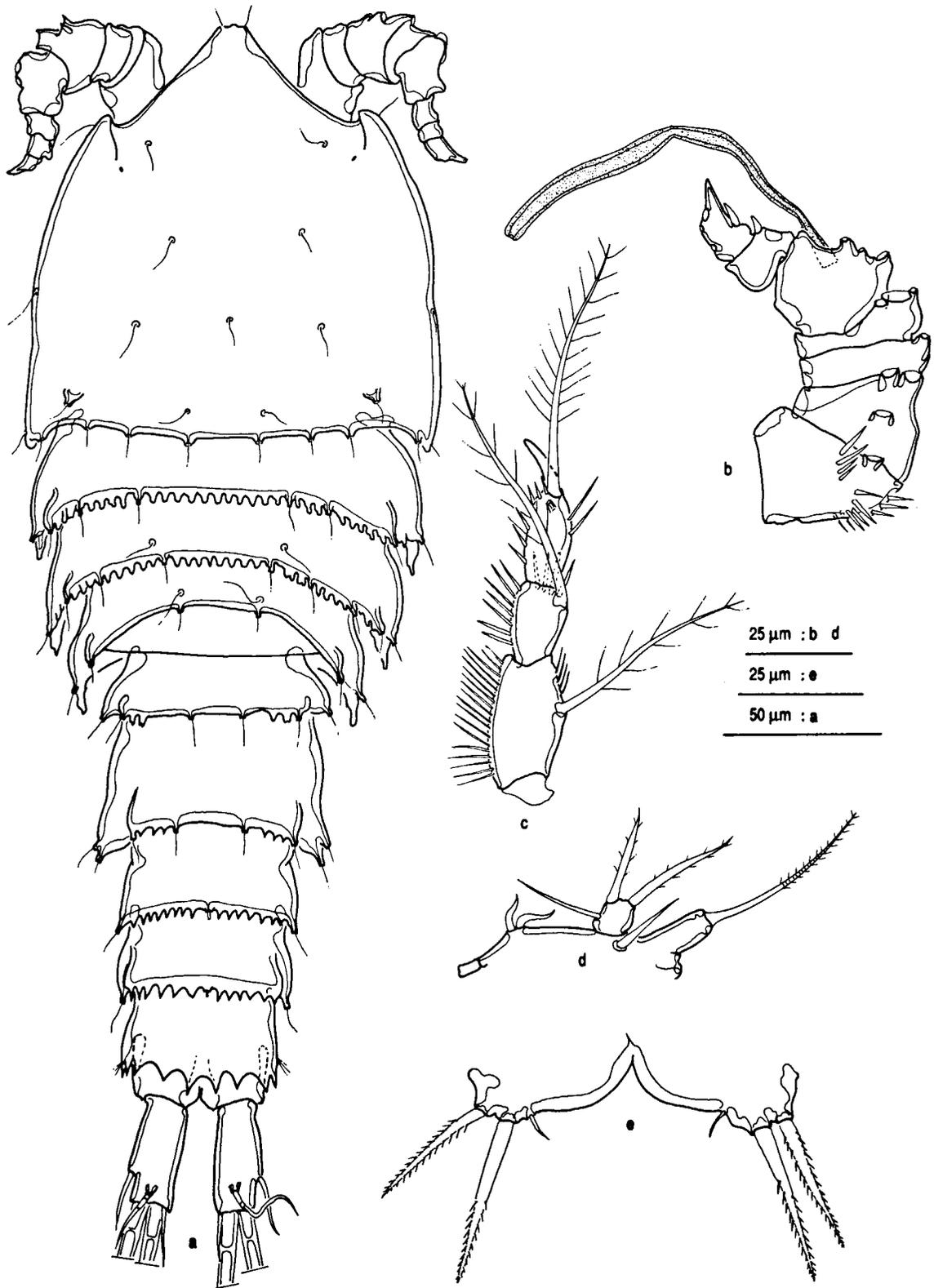


Fig. 4. *Zosime pacifica* n. sp., male: a. habitus, dorsal; b. antennule; c. endopodite P2; d, P5; e, P6.

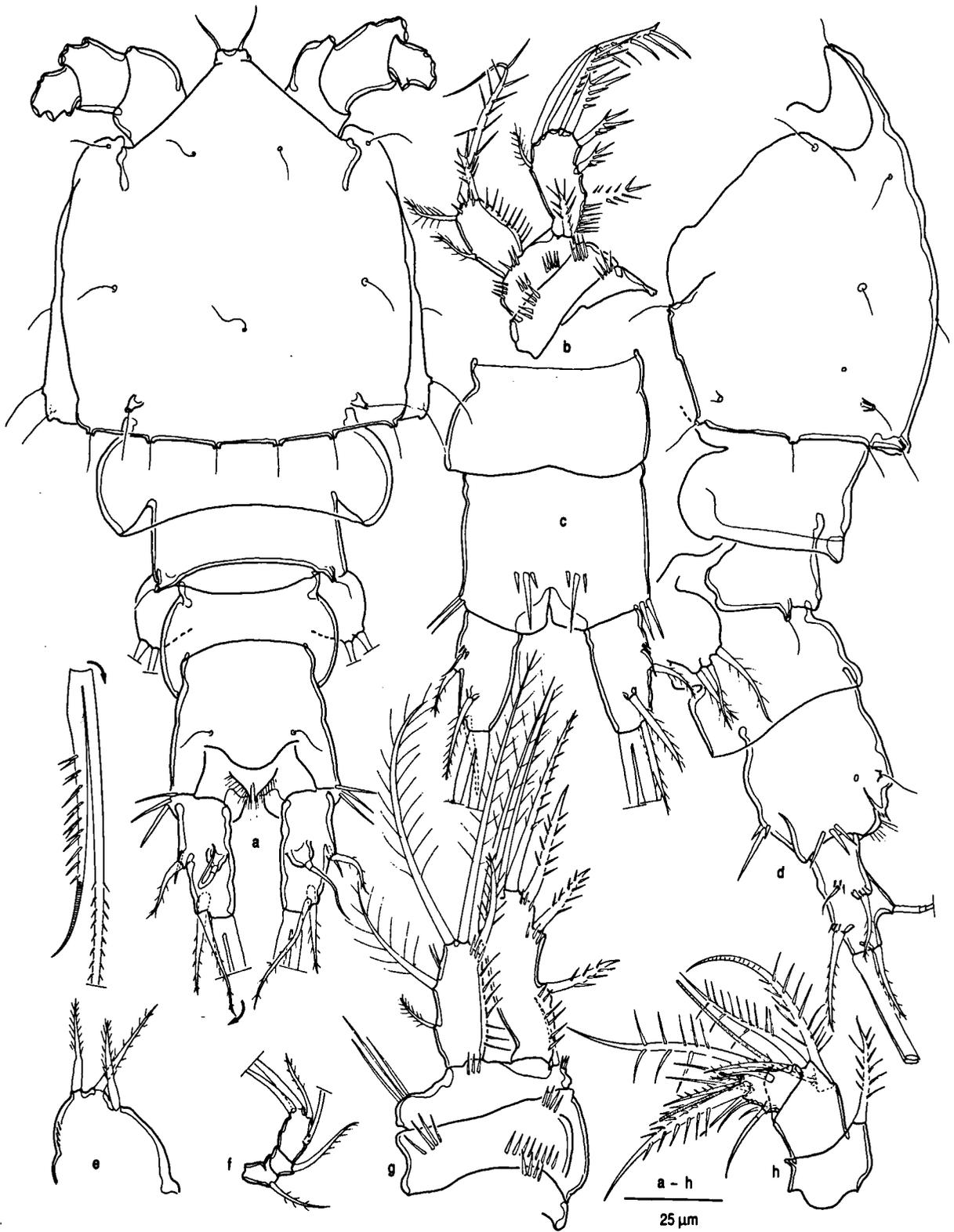


Fig. 5. *Zosime pacifica* n. sp., copepodid I: a, habitus, dorsal; b, P1, c, penultimate and anal segment, ventral; d, habitus, lateral; e, P3; f, exopodite of the antenna; g, P2; h, antennule.

Table II: Chaetotaxy of the copepodids of *Zosime pacifica* n. sp.

legs	Cop I	Cop II	Cop III	Cop IV	Cop V
P1 exo	1,II,IV	0,I-2,II,II	0,I-2,II,III	0,I-2,II,III	0,I-1,I-1,II,III
P1 end	2,I,I	1,0-1,I,I	1,0-1,I,I	1,0-1,II,I	1,0-1,2,I
P2 exo	1,II,III	0,I-2,II,II	1,I-3,II,III	1,I-3,II,III	1,I-1,I-3,II,III
P2 end	2,2,I	1,0-1,2,I	1,0-2,2,1	1,0-2,2,I	1,0-1,0-1,2,I
P3 exo	3	1,I,III	1,I-2,II,II	1,I-3,II,III	1,I-1,I-3,II,III
P3 end		2,2,I	1,0-1,2,1	1,0-2,2,I	1,0-1,0-1,2,I
P4 exo	-	3	1,II,III	0,I-3,II,III	1,I-1,I-3,II,III
P4 end			2,2,1	1,0-2,2,I	1,0-1,0-1,2,I
P5 exo	-	-	3	3	3
P5 bas				2+1*	2+1*
P6	-	-	-	1	3

\* 2 setae on the endopodal lobe + 1 near the basis of the exopodite.

P3 (Fig. 5 e) represented as an ovate plate, bearing three setulose setae.

#### Copepodid II

Habitus (Fig. 6 a) 250  $\mu$ m long. Body with six somites. Cephalothorax with curved lateral margins and bending strongly anteriad. Integument and posterior margins of the somites smooth except for the spinules arising along the posterior edges and median ventral surface of the anal segment. Rostrum as in the preceding stage.

Furcal rami twice as long as wide. Two lateral setae and the dorsal one implanted near the middle and one ventral seta arising near the distal edge. Outer principal seta shorter than the ramus. Inner principal and inner apical setae as in the adult.

Antennule (Fig. 6 e) four-segmented, bearing an aesthetasc on the second and ultimate segments. Appearance of the setae as in Cop I. Antenna and mouthparts as in the adult.

P1 (Fig. 6 b) and P2 (Fig. 6 f) with protopodites as in the adult. Rami two-segmented, chaetotaxy in Table II. Basis of P1 with an inner spine, reaching almost to the apical edge of the endopodite.

P3 (Fig. 6 g) with smooth protopodal parts and one-segmented rami. Chaetotaxy in Table II.

P4 (Fig. 6 d) represented as a small ovate socle, bearing three setulose setae.

#### Copepodid III

Habitus (Fig. 7 a) resembling the adult facies closely except for the smooth integument and posterior margins of the thoracic segments. Body composed of seven somites. Length 360  $\mu$ m. Posterior margins of the fifth and sixth segments set with irregularly rounded extensions.

Anal operculum convex and furcal rami as in the adult. Antennule (Fig. 8 e) four-segmented. Aesthetascs arising from the second and ultimate segments. Antenna with a three-segmented exopodite with an adult appearance (Fig. 8 d). Other mouthparts as in the adult.

P1-P3 (Fig. 7 b, c, e, respectively) with distinct protopodal components and two segmented rami. Shape and armature of the exopodal spines as in the adult. Chaetotaxy in Table II.

P4 (Fig. 7 f) with distinct coxa and basis. Exopodite and endopodite one-segmented with chaetotaxy as listed in Table II.

P5 (Fig. 7 d) represented as a slight elevation, bearing three setae, the outermost feathered and longer than the two inner smooth ones.

#### Copepodid IV (female)

Body facies as in the adult, composed of eight segments (Fig. 9 a). Length 380  $\mu$ m. Antennule (Fig. 8 f) five-segmented with aesthetascs on the

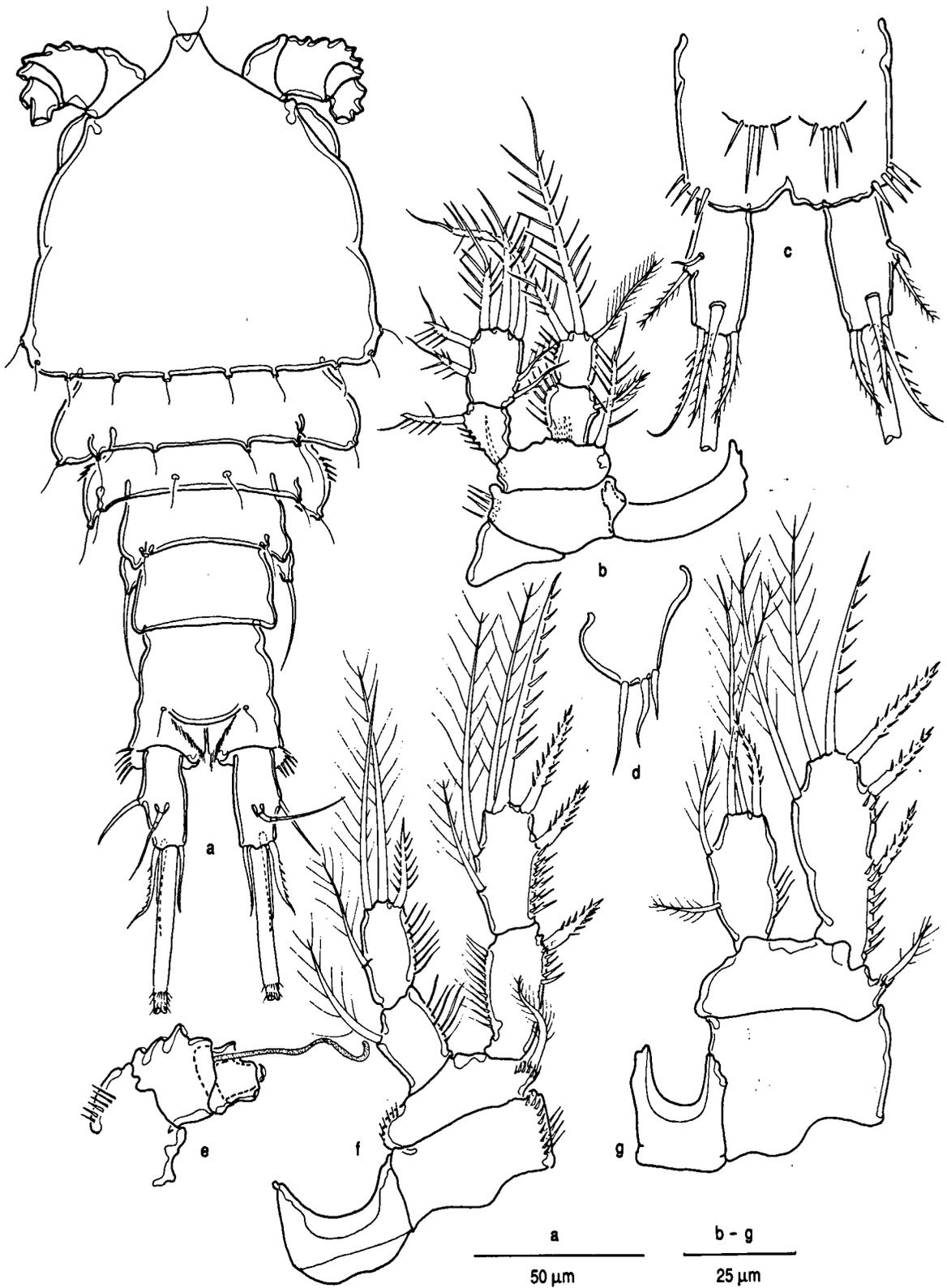


Fig. 6. *Zosime pacifica* n. sp., copepodid II: a, habitus, dorsal; b, P1, c, anal segment, ventral; d, P4; e, antennule; f, P2; g, P3.

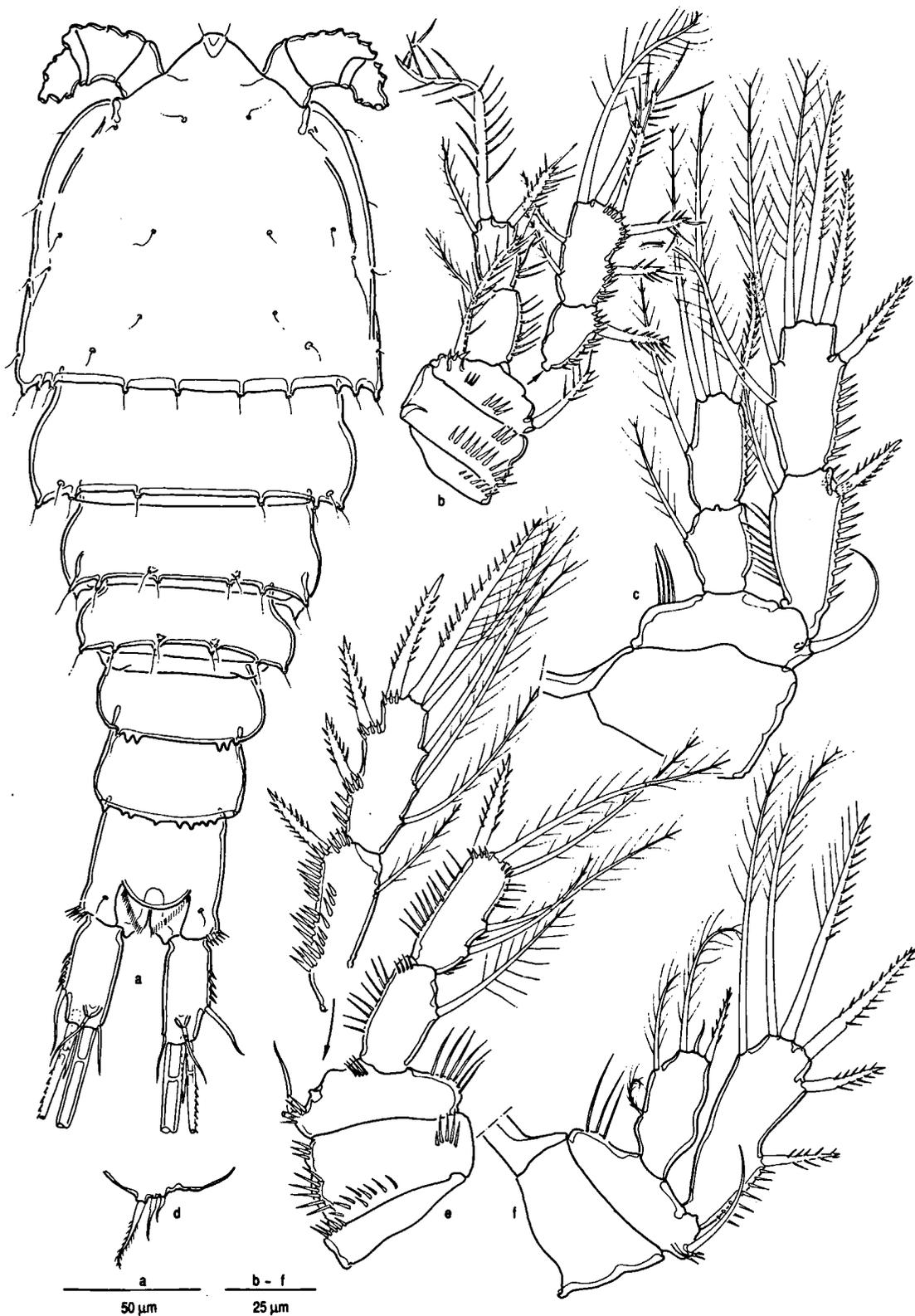


Fig. 7. *Zosime pacifica* n. sp., copepodid III: a, habitus, dorsal; b, P1, c, P3; d, P5; e, P2; f, P4.



Fig. 8. *Zosime pacifica* n. sp., copepod III: a, P1; b, P2; c, P4; d, exopodite of antenna; e, antennule; copepod IV: f, female antennule; g, ultimate segment of male antennule; copepod V: h, male antennule.

second and ultimate segment. Mouthparts as in the preceding stage.

P1-P4 (Fig. 8 a, b, c) with two-segmented rami. Integumental structures more dense than in copepodid III. P3 almost identical with P2, differs only by the slightly shorter endopodite. Chaetotaxy in Table II.

P5 (Fig. 9 b) with a distinct inner baseoendopodal lobe (with two setae), a distinct exopodal lobe (with three setae) and a small socle, bearing one seta, near the outer proximal edge of the exopodal lobe. Baseoendopodite still fused with the supporting segment.

P6 (Fig. 9 g) represented as an oblong ovate plate, bearing one long spinulose seta and a small rounded processus near the outer distal margin.

#### Copepodid IV male.

Habitus, length, mouthparts and natatorial legs as in the female. Antennule differing from that of the female by a small rounded process on the apicalmost edge of the last segment (Fig. 8 g).

P5 (Fig. 9 c) with a less differentiated exopodal lobe, bearing three setae and much smaller endopodal setae.

P6 (Fig. 9 h) as in the female but without an invagination between the opposite legs.

#### Copepodid V (female)

Body with nine segments. General appearance more slender than in the adult (Fig. 9 f). Free genital segments. Length 400  $\mu\text{m}$ . Antennule, mouthparts and legs as in the adult.

P5 (Fig. 9 d) almost identical with that of the adult but still fused with the supporting segment and showing shorter setae.

P6 (Fig. 9 i) represented as a slightly elevated socle along the posteroventral margin of the segment, bearing three minute setae.

#### Copepodid V (male)

Habitus and length as in the female copepodid V. Antennule (Fig. 8 h) six-segmented with the aesthetasc on the second segment. Ultimate segment slightly prolonged, forming a rather thick but sharp extension.

Mouthparts and natatorial legs as in the adult. P3 endopodite as in the female copepodid V, not dimorphic.

P5 (Fig. 9 e) as in the preceding stage except for the larger exopodal lobe and the slightly longer endopodal setae.

P6 (Fig. 9 j) represented as a small elevation on the outer ventral edge of the segment and bearing three setae. Outer and median seta spinulose, inner one smooth and short.

*Discussion.* — *Zosime pacifica* n.sp. is unique among the species of the genus because of the remarkably reduced apical seta on the endopodite of the P4. Although several species of the genus *Zosime* are described without illustrations of the natatorial legs, a comparable reduction of a seta has never been mentioned. Moreover, species discrimination within the genus is mainly based on the chaetotaxy of the legs. It seems obvious that if reduced setae were present they would have been observed.

Within the genus, *Z. pacifica* n. sp. resembles most closely *Z. valida* G.O. Sars, 1919. Both species possess a P5 with only two inner baseoendopodal setae which discriminates them from all other members of the genus. However, *Z. pacifica* n. sp. is easily distinguishable from its congener by the above mentioned reduced seta on the P4 and by the chaetotaxy of the P1 endopodite, bearing four setae/spines on the second segment instead of three as in *Z. valida*.

#### Family Cletodidae T. Scott, 1904

#### Genus *Cletodes* Brady, 1872

Including the two herein described species, the genus *Cletodes* comprises 21 different species. Since the compilation of the most recent key (Hamond, 1973) four species, *Cl. reductus* Moore, 1978 *Cl. dorae* Por, 1979, *Cl. setosus* Marinov & Apostolov, 1985 and *Cl. endopodita* (Schriever, 1984) were added. A revised key, discriminating females as well as males, is given below. *Cl. brucei* T&A Scott, 1901 and *Cletodes* sp. (Krishnaswamy, 1957) are omitted. The male characteristics of *Cl. millerorum* Hamond,

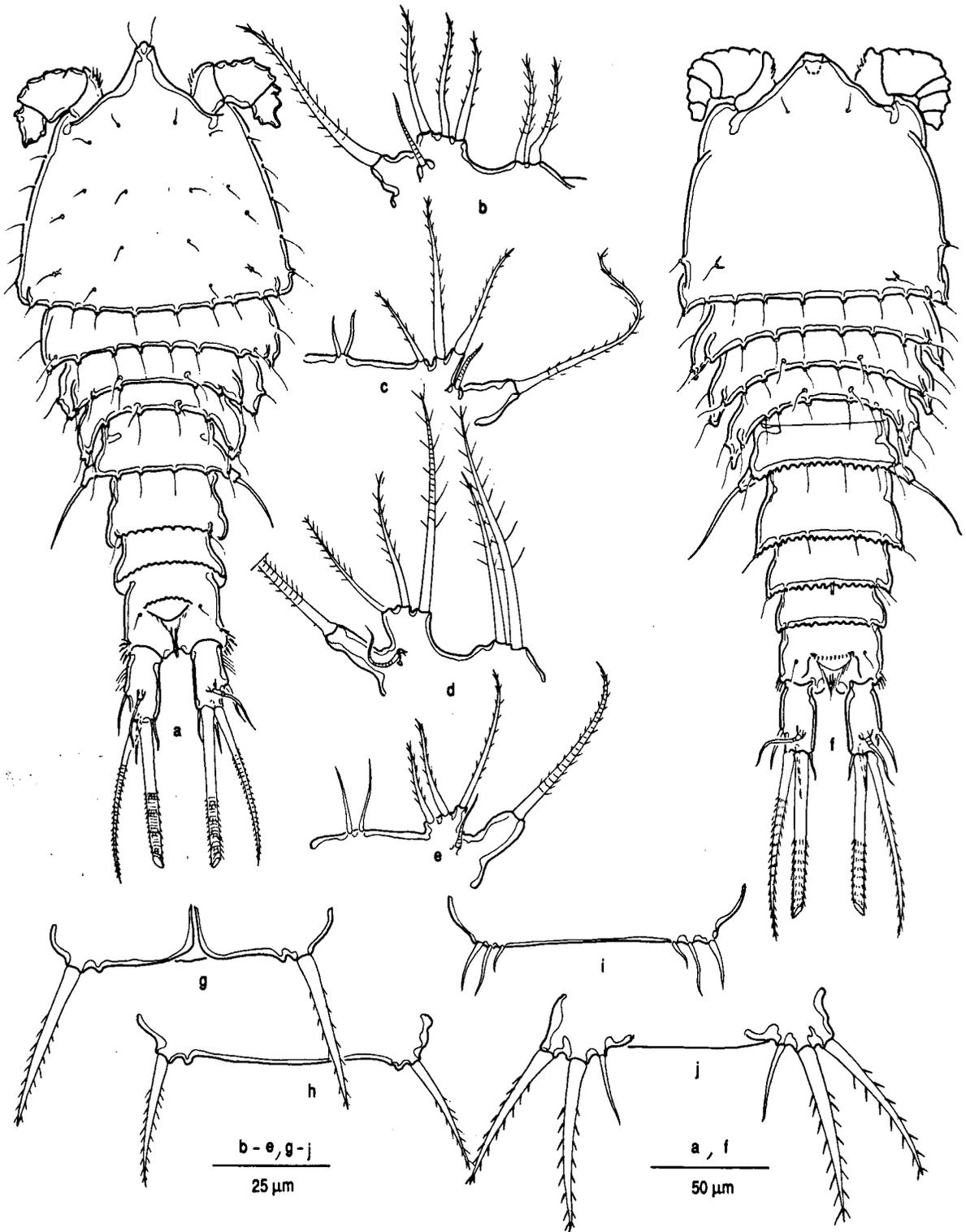


Fig. 9. *Zosime pacifica* n. sp.: a, habitus (Cop IV); b, female P5 (Cop IV); c, male P5 (Cop IV); d, female P5 (Cop IV); e, male P5 (Cop V); f, habitus (Cop V); g, female P6 (Cop IV); h, male P6 (Cop IV); i, female P6 (Cop V); j, male P6 (Cop V).

1973 (untransformed endopodite P3, baseoendopodite P5 without setae, exopodite P5 with three setae) are included, based on specimens found in the present collection. The description of the male will be given in detail elsewhere.

In the present key the baseoendopodite of the female P5 of *Cl. jotabis* is considered to have three setae instead of four as originally stated by Por (1967) and listed by Hamond (1973: Table 3B, p. 480), later on in his revision of the genus. The position of the inner distal seta and the statement that this seta is reduced (Por, *op cit.*) clearly indicates that this structure represents a hyaline tubular pore identical with those discussed by Bodin (1970) for *Cl. limicola* Brady, 1872 and *Cl. tenuipes* T. Scott, 1896.

#### Key to the species

- 1 - P3 exo 2 without, P4 exo 2 with an inner seta..... 2
  - P3 exo 2 and P4 exo 2 without inner seta..... 5
  - P3 exo 2 and P4 exo 2 with an inner seta..... 9
- 2 - Furcal rami rather short, about as long as the anal segment .....
  - .. *Cl. setosus* Marinov & Apostolov, 1985
  - Furcal rami much longer, at least twice as long as the anal segments ..... 3
- 3 - P2 end 2 with one apical seta only; exo P5 three times as long as wide in the female, 2.5 times in the male *Cl. tuberculatus* n. sp.
  - P2 end 2 with two setae, inner one slender; exo P5 with different lengths. 4
- 4 - Furcal rami strongly tapering posteriad; female and male exo P5 twice as long as wide..... *Cl. reductus* Moore 1978
  - Furcal rami cylindrical; female and male exo P5 3-3.5 times as long as wide ..... *Cl. smirnovi* Bodin 1970
- 5 - Baseo P5 of females and exo P5 of males with three setae/spines; P3 end of males two segmented without apophysis .... 6
  - Baseo P5 of females with one, exo P5 of males with four setae/spines; P3 end of males three-segmented with apophysis 7
- 6 - Furcal rami elongated ovate (L/W: 3/1);

- male end P3 with a large spine and seta ..... *Cl. dorae* Por 1979
- Furcal rami broadly ovate (L/W: 2/1); male end P3 with a small and a long seta ..... *Cl. hartmannae* Lang 1965
- 7 - P2 exo 2 with an inner seta ..... *Cl. pusillus* Sars 1920
  - P2 exo 2 without inner seta ..... 8
- 8 - P4 end 2 with two setae; P4 end 1 small, less high than wide ..... *Cl. endopodita* (Schriever 1984)
  - P4 end 2 with one seta; P4 end 1 as long as wide ..... *Cl. tenuipes* T. Scott 1896
- 9 - P2 end 2 and P4 end 2 with two setae . ..... *Cl. longifurca* Lang 1948
  - P2 end 2 and P4 end 2 with four setae . ..... *Cl. latirostris* Drzycimski 1967
  - P2 end 2 with two setae, P4 end 2 with three setae ..... 10
  - P2 end 2 with two setae, P4 end 2 with four setae ..... 13
- 10 - Female P5 exo with four setae, male unknown *Cl. carthaginiensis* Monard 1935
  - Female P5 exo with five setae, male known ..... 11
- 11 - Female baseo P5 with two setae; furcal rami nearly cylindrical; male P3 end transformed ..... *Cl. reysi* Soyer 1964
  - These characteristics not combined . 12
- 12 - Furcal rami ovate, at the most three times as long as wide; male P5 exo with three setae ..... *Cl. limicola* Brady 1872
  - Furcal rami nearly cylindrical, slightly tapering posteriad, at least six times as long as wide; male P5 exo with two setae (lateral one absent) ..... *Cl. longicaudatus* (Boeck 1872)
- 13 - Furcal rami not ovate in dorsal view, at least five times as long as wide; female P3 end 2 with four setae; male end P3 transformed ..... 14
  - Furcal rami ovate in dorsal view about three times as long as wide; female P3 end 2 with three setae; male end P3 not transformed ..... 15
- 14 - Outer subdistal spine of P3 and P4 end 2 implanted near the distal edge; P1 end reaching to the middle of P1 exo 3; male

- P5 with 2 baseoendopodal smooth setae ..... *Cl. macrura* n. sp.
- Outer subdistal spine of P3 and P4 end 2 implanted far below distal edge; P1 end reaching to the distal margin of P1 exo 3; male baseoendopodite P5 without setae ..... *Cl. yotabis* Por 1967
- 15 - Inner seta of female P5 baseoendopodite setulose; furcal rami equally in both sexes ..... *Cl. spinulipis* Por 1967
- Inner seta of female P5 baseoendopodite stout, spinulose and rather short; furcal rami differing in both sexes ..... 16
- 16 - Largest width of the female furcal rami situated in the anterior half ..... 17
- Largest width of the female furcal rami situated in the posterior half (male unknown) ..... *Cl. dissimillis* Willey 1935
- 17 - Proximal outer spine of P4 exo 3 much shorter than subdistal one; female furcal rami as long as the anal segment .....  
..... *Cl. pseudodissimilis* Coull 1971
- Proximal outer spine of P4 exo 3 only slightly shorter than subdistal one; female furcal rami longer than the anal segment ..... *Cl. millerorum* Hamond 1973

**Cletodes macrura** n. sp.

Type-region. — Pacific Ocean, Santa Maria Basin, California (U.S.A.) between Punta San Luis and Purisma Point, at a depth ranging from 50 to 565 m.

Type material. — Holotype: one dissected female, mounted on three slides from station PJ 7-2 (ZMA Coll. no. Co.102.863); allotype: one dissected male, mounted on two slides from station PJ 7-2; (ZMA Coll. no. Co.102.864); paratypes: dissected, 2 females (M.S.I.); 1 male (M.S.I.); 2 Cop I (COP 3169, 3173); 1 Cop II (COP 3174); 1 Cop III (COP 3175); 1 Cop IV (COP 3171); 2 Cop V (COP 3170, 3172); preserved: 12 females, 17 males, 9 Cop II, 7 Cop III, 6 Cop IV (females), 1 Cop V (female) (ZMA Coll. no. Co.102.865 — 102.866, COP 3157-3168 and M.S.I.).

Etymology. — The specific name *macrura*, a conjunction of the Greek words *makros* (long) and *aura* (tail), refers to the long furcal rami.

*Description.*

Adults

Female: habitus (Fig. 10 a, b) fusiform, slightly tapering posteriorly. Length, including rostrum and furcal rami, 550  $\mu$ m. Head rather small, about one fifth of the entire body length. Cephalothorax, in dorsal view, with rounded lateral margins and a distinct constriction in the posterior half. Body segments constricted in the anterior half and widening with smoothly curved lateral margins posteriorly. Fifth thoracic and genital segments markedly extended laterally. Pre-anal and anal segment cylindrical. Anal operculum straight, lateral edges shaped by conical structures bearing the sensillae.

Integument of thoracic and abdominal pleurotergites clothed with an irregular pattern of minute spinules, that of the head furnished with an irregular pattern of fine lines. Posterior margins of the thoracic pleurotergites smooth. Pleural region of the genital segments and anal segments set with some spinules. Posteroventral margin of the second and third abdominal segments spinulose (Fig. 11 a). Ventral surface of the genital segments smooth.

Genital field strongly sclerotized, bearing a single seta on each side.

Rostrum (Fig. 11 c) with a slightly curved rostral tip, set with fragile hairs.

Furcal rami 5.5 times as long as wide, tapering towards the distal edge. Inner margin slightly undulating. Dorsal seta implanted in the posterior half. Two lateral setae arising almost medially and one subdistally. Outer principal seta small, as long as the inner apical one and fused with the principal one. Surface of the rami spinulose.

Antennule (Fig. 11 h) five-segmented, showing long spinules on the first segment. Most setae on the first to fourth segments setulose. Ultimate segment with strongly armed spines and some smooth setae. Aesthetascs implanted on the third and fifth segments.

Antenna (Fig. 11 j) with allobasis, having a transversal ridge beyond the articulation with the exopodite and one subdistal seta. Exopodite

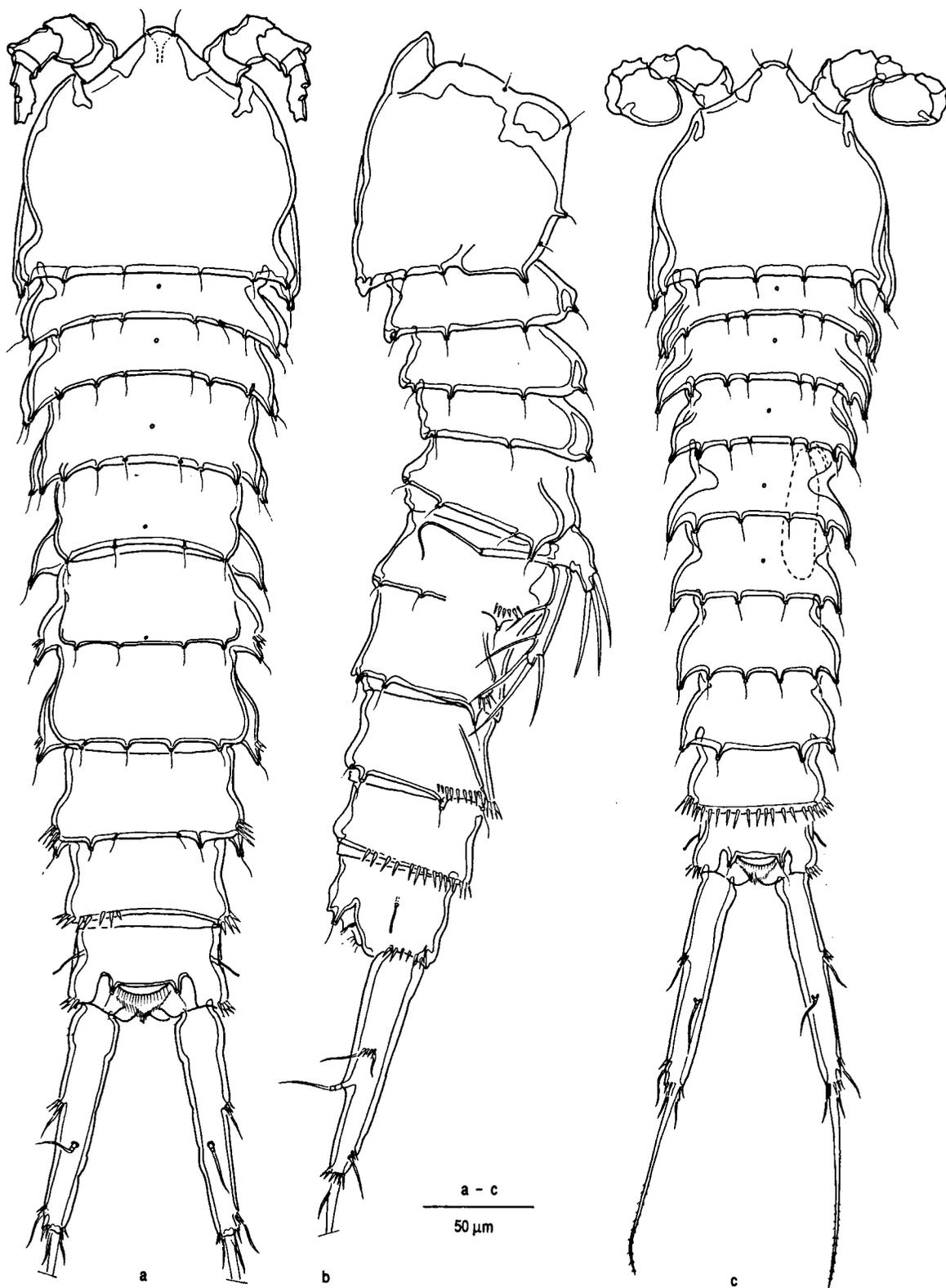


Fig. 10. *Cletodes macrura* n. sp.: a, female habitus, dorsal; b, female habitus, lateral; c, male habitus, dorsal.

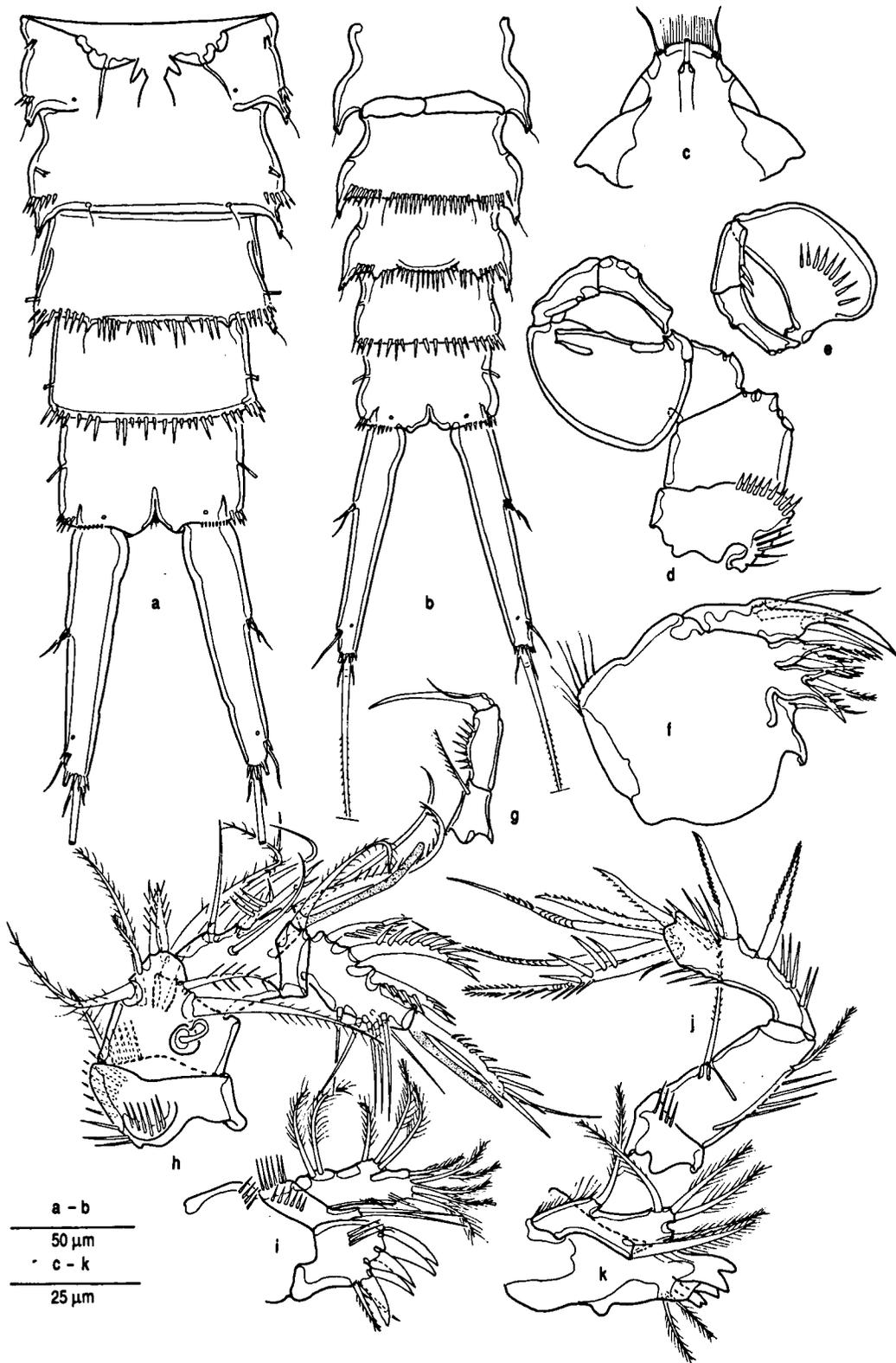


Fig. 11. *Cletodus macrura* n. sp.: a, female abdomen, ventral; male abdomen, ventral; c, rostrum, ventral; d, male antennule, ventral; e, ultimate segments of the male antennule, dorsal; f, maxilla; g, maxilliped; h, female antennule; i, maxillule; j, antenna; k, mandible.

Table III: Chaetotaxy of *Cletodus macrura* n. sp.

	P1	P2	P3	P4	P5♀	P6♂
exo	0-0-022	0-1-022	0-1-022	0-1-022	5	4
end	0-111	0-020	0-121	0-121	3	2

small, slightly longer than wide, bearing a single seta. Endopodite with three lateral and six distal spines/setae.

Mandible (Fig. 11 k) with a large, strongly sclerotized gnathobasis, bearing two setae and three strong teeth. Palp with vestigial endopodite represented as a single seta. Exopodal lobe distinct but fused, bearing four setae. Apical seta of the palp distinctly stronger than the other ones.

Arthrite of the maxillule (Fig. 11 i) with two setae and five unarmed curved spines. Coxa with two slender setae and basis with six apical and five lateral setae.

Maxilla (Fig. 11 f) large and compact. Syncoxa strongly sclerotized, having three endites. Proximal endite represented as a slender seta, median and distal endites each with two armed and one smooth seta. Basis with three setae and typically hook-shaped. Unarmed.

Maxilliped (Fig. 11 g) small, less high than the maxilla. Basis with a single seta. Endopodal segment set with strong spinules along the inner margin. Claw unarmed and bearing a long seta.

P1-P4 (Fig. 12 b, c, e, g, respectively) with three-segmented exopodites and two-segmented endopodites. Coxae and bases with spinules. Bases of P2-P4 laterally prolonged. Basis of the P1 with an inner seta reaching far beyond the endopodite. Third exopodal segment of the P4 with an invagination along the inner margin, probably representing a pore orifice. Chaetotaxy of the legs in Table III.

P5 (Fig. 12 d) Baseoendopodite with a long cylindrical outer extension, bearing the outer seta. Endopodal lobe of the baseoendopodite protruded, having three setae. Hyaline pore not observed. Exopodite with nearly parallel margins, six times as long as wide and bearing five setae.

Male: habitus (Fig. 10 c) resembling the female closely but more slender and slightly more tapering posteriorly. Length 480 µm. Integumental structures as in the female except for an additional row of spinules along the posteroventral margin of the first abdominal segment (Fig. 11 b).

Furcal rami as in the female only slightly more slender.

Antennulae (Fig. 11 d, e) six-segmented, sub-chirocer. First and second segments as in the female. Ultimate segments long, nearly cylindrical. Fourth segment with a curved row of long spinules on the dorsally directed surface.

P3 (Fig. 12 a) with a three-segmented endopodite, carrying a long, S-shaped apophysis on the second segment and only two setae on the terminal segment.

P5 (Fig. 12 f) with a small but distinct endopodal lobe on the baseoendopodite, bearing two smooth setae. Inner seta rigid, outer one slender. Exopodite 3.5 times as long as wide and having four setae.

P6 (Fig. 11 b) represented as an oblong plate, without setae.

Variability. — The holotype specimen lacks the continuous row of spinules along the dorsal border of the pre-anal segment.

## Copepodids

### Copepodid I

Habitus (Fig. 13 a) tapering strongly posteriad. Body composed of five segments. Length of cephalothorax more than one third of the entire body length. Largest width near the posterior margin of the head. Anal segment constricted anteriorly, having a convex and setulose anal operculum. Length, including rostrum and furcal rami, 155 µm. Dorsal integument of the segments spinulose. Anal



Fig. 12. *Cletodes macrura* n. sp., copepodid I: a, habitus, dorsal; b, anal segment, lateral; c, anal segment, ventral; d, P1; e, P2; f, antennule; g, exopodite of the antenna; copepodid II: h, habitus, dorsal; i, P1; j, P2; k, P3; l, antennule; m, exopodite of the antenna.

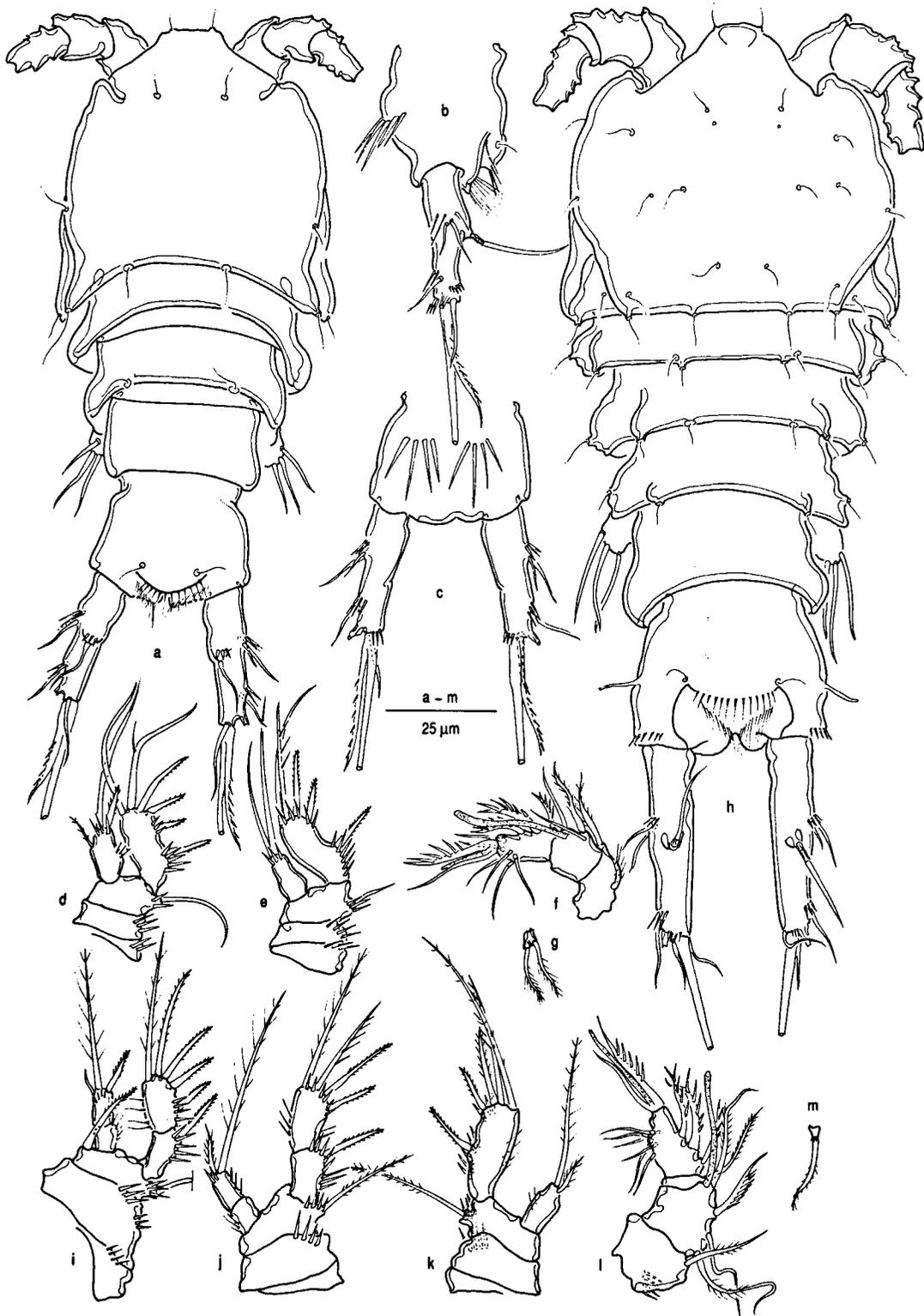


Table IV: Chaetotaxy of the copepodids of *Cletodes macrura* n. sp.

legs	Cop I	Cop II	Cop III	Cop IV	Cop V
P1 exo	0,1I,IV	0,I-0,1I,III	0,I-0,1I,III	0,I-0,1I,III	0,I-0,I-0,1I,II
P1 end	1,1,I	0,0-1,1,I	0,0-1,1,I	0,0-0,1,I	0,0-0,1,I
P2 exo	0,1I,III	0,I-0,1I,II	0,I-1,1I,III	0,I-1,1I,III	0,I-0,I-1,1I,II
P2 end	0,2,0	0,0-0,2,0	0,0-0,2,0	0,0-0,2,0	0,0-0,2,0
P3 exo	3	0,1I,III	0,I-0,1I,II	0,I-1,1I,III	0,I-0,I-1,1I,II
P3 end	-	0,2,0	0,0-0,2,I	0,0-0,2,I	0,0-1,2,I
P4 exo	-	3	0,1I,III	0,I-1,1I,III	0,I-0,I-1,1I,II
P4 end	-	-	0,2,0	0,0-0,2,I	0,0-1,2,I
P5 exo	-	-	3	5	5/4*
P5 bas	-	-	-	2	3/2
P6	-	-	-	-	-

\*: chaetotaxy in the female/male

segment with two transversal rows of long rigid spinules ventrally (Fig. 13 b, c).

Furcal rami (Fig. 13 a, b, c) three times as long as wide, slightly convex in the anterior half of the inner margin. Dorsal seta arising in the middle, close to the inner margin. Two lateral setae implanted in the anterior half and one lateral seta implanted in the posterior third. Second dorsal seta near the distal margin. Principal distal setae fused, the outer one as long as the ramus. Outer distal edge of each ramus showing a well defined tubular pore.

Rostrum with smoothly bent lateral margins and a straight anterior tip.

Antennule (Fig. 13 f) three-segmented, bearing an aesthetasc on the second and third segments. Most setae spinulose. Antenna (Fig. 13 g) resembling the adult shape closely but having a larger exopodite, bearing two setae. Mouthparts as in the adult.

P1-P2 (Fig. 13 d, e, respectively) with distinct protopodal components. P1 basis without inner seta. Endopodites and exopodites one-segmented, chaetotaxy listed in Table IV.

P3 (Fig. 13 a) represented as a distinct socle, bearing three equal setae.

#### Copepodid II

Habitus (Fig. 13 h) tapering. Cephalothorax with strongly folded posterolateral surface. Thoracic segments 1-3 sixth rigid integumental

elevations dorsally. Length, 210  $\mu$ m.

Integumental structures as in copepodid I.

Furcal rami nearly five times as long as wide, slowly tapering posteriad. Dorsal seta implanted in the middle of the rami. Proximal lateral setae as in Cop I but distal lateral seta implanted closer to the edge of the rami. Outer principal seta and inner distal seta small and smooth.

Antennule (Fig. 13 l) four-segmented, bearing the aesthetascs on the second and fourth segments. Exopodite of antenna (Fig. 13 m) small, having only one feathered sets.

P1-P2 (Fig. 13 i, j, respectively) with two-segmented rami. Basis of P1 with an inner seta, reaching beyond the distal edge of the second endopodal segment. P3 (Fig. 13 k) with distinct protopodal components and one-segmented rami. Chaetotaxy of the legs in Table IV.

F4 (Fig. 13 h) represented as three setae on a distinct lobe.

#### Copepodid III

Body (Fig. 14 a) seven-segmented with facies resembling the preceding stage. Length 280  $\mu$ m. Furcal rami as in copepodid II.

Antennule (Fig. 14 e) four-segmented with an aesthetasc on the second and ultimate segments. Antennule and mouthparts as in the adult.

P1-P3 (Fig. 14 b, c, d, respectively) with

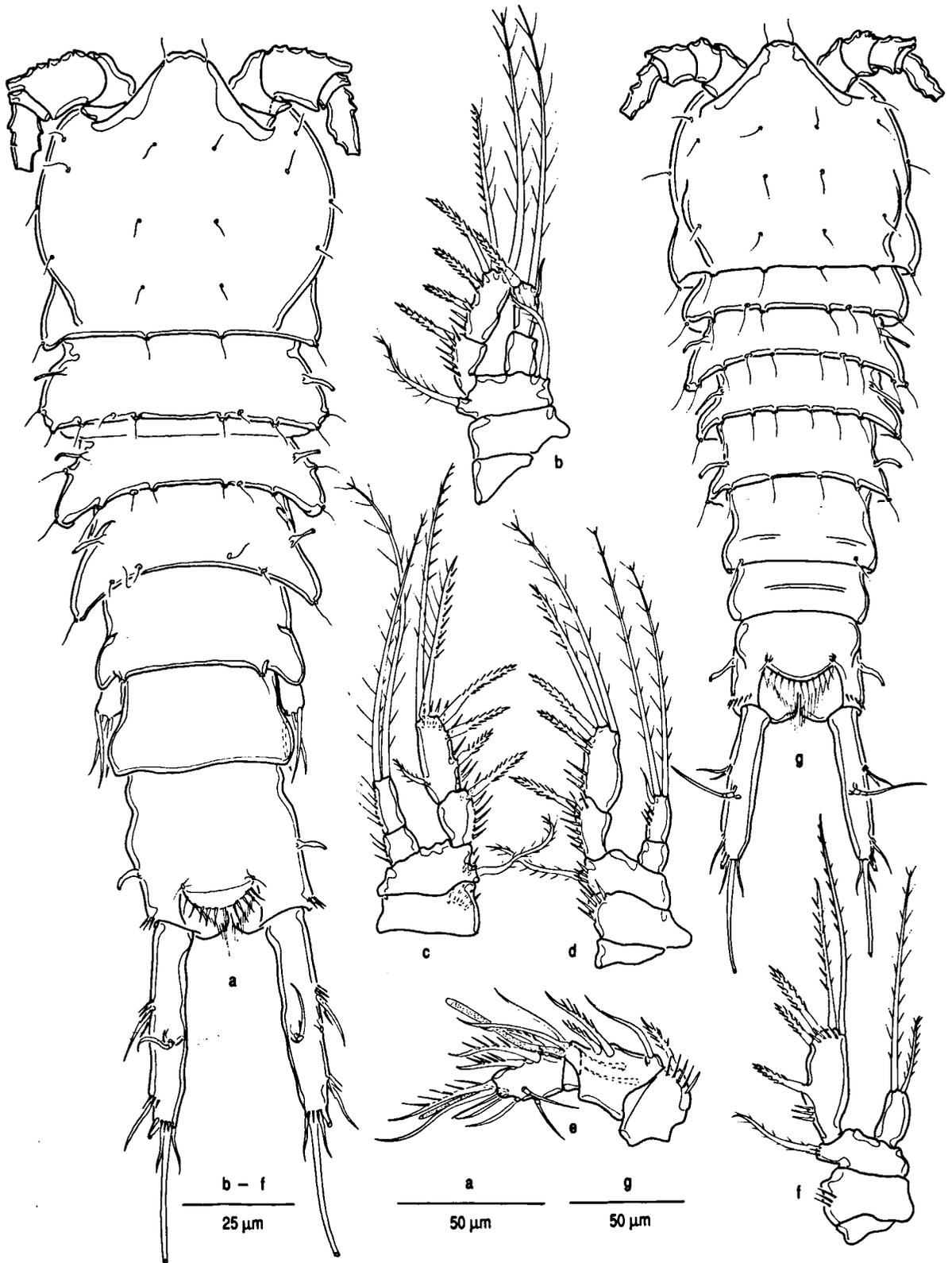


Fig. 14. *Cletodes macrura* n. sp., copepodid III: a, habitus; b, P1; c, P2; d, P3; e, antennule; f, P4; copepodid IV: g, habitus.

distinct protopodal components and two-segmented rami. Chaetotaxy listed in Table IV.

P4 (Fig. 14 f) with prae-coxa, coxa and basis. Exopodite and endopodite one-segmented. Chaetotaxy in Table IV.

P5 (Fig. 14 a) represented as an elevation bearing three setae.

#### Copepodid IV (female)

Habitus (Fig. 14 g) resembling the adult body shape closely except for the smaller length (350  $\mu\text{m}$ ) and fewer body segments (eight).

Antennule (Fig. 15 f) five-segmented with the aesthetascs on the third and last segments. General appearance as in the adult.

P1-P4 (Fig. 15 a, b, c, respectively) with two-segmented rami. Integumental structures and shape of spines resembling closely the adult form.

P5 (Fig. 15 e) with a slightly protruded baseoendopodite, still fused with the supporting segment, and bearing two endopodal setae and one outer seta arising from a long cylindrical extension. Exopodal lobe distinct, about twice as long as wide and having five setae.

P6 not differentiated.

Male copepodid IV not found.

#### Copepodid V (female)

Habitus as in the preceding stage but 480  $\mu\text{m}$  long and composed of nine segments. Antennule and mouthparts as in the adult. P1-P4 with three-segmented exopodites and endopodites smaller than in the adult legs. Chaetotaxy in Table V.

P5 (Fig. 15 h) still fused with the body segment. Inner baseoendopodal lobe with three setae. Exopodite oblong, nearly three times as long as wide and bearing five setae.

P6 not differentiated.

#### Copepodid V (male)

Habitus, length and mouthparts as in the female. Antennule (Fig. 15 j) four-segmented with aesthetasc on the third and last segments. Last segment long and slightly extended with a rounded process distally.

P3 (Fig. 15 j) with protopodite and exopodite as in the female copepodid V. Endopodite two-segmented bearing two apical setae, one inner, minute seta and a large, robust, outer subdistal spine on the second segment. Frontal surface of the second segment showing a sclerotized transversal ridge near the implantation of the outer subdistal spine.

P5 (Fig. 15 g) bearing two baseoendopodal setae and four exopodal ones. Exopodite about 2.5 times as long as wide and still fused with the baseoendopodite.

P6 not differentiated.

*Discussion.* — *Cl. macrura* n. sp. resembles *Cl. yotabis* Por, 1967 in many aspects. Chaetotaxy of the legs and shape of the furcal rami are nearly identical in both species. The here described species differs from the latter by the more conventional implantation of the outer subdistal spines on the endopodites in P3 and P4. Whereas in *Cl. yotabis* these spines arise near the middle of the outer margin of the segment, opposite the implantation of the inner lateral seta, the subdistal outer endopodal spines in *Cl. macrura* n. sp. are implanted just below the outer edge of the segment.

The males of both species differ markedly in chaetotaxy of their P5. The exopodite of this leg in *Cl. macrura* bears four setae, while the baseoendopodite has a distinct inner lobe and carries two long smooth setae. In *Cl. yotabis* the male P5 lacks baseoendopodal setae and has only three setae on the exopodite.

Other differences between both species are the body length (*Cl. macrura*: 550  $\mu\text{m}$ , *Cl. yotabis*: 420-480), the strongly developed maxillule and the smooth anal operculum in *Cl. macrura*.

#### *Cletodes tuberculatus* n. sp.

Type-region. — Pacific Ocean, Santa Maria Basin, California (U.S.A.) between punta San Luis and Purisma Point, at a depth ranging between 50 to 565 m.

Type-material. — Holotype: one dissected female, mounted on two slides from station PJ

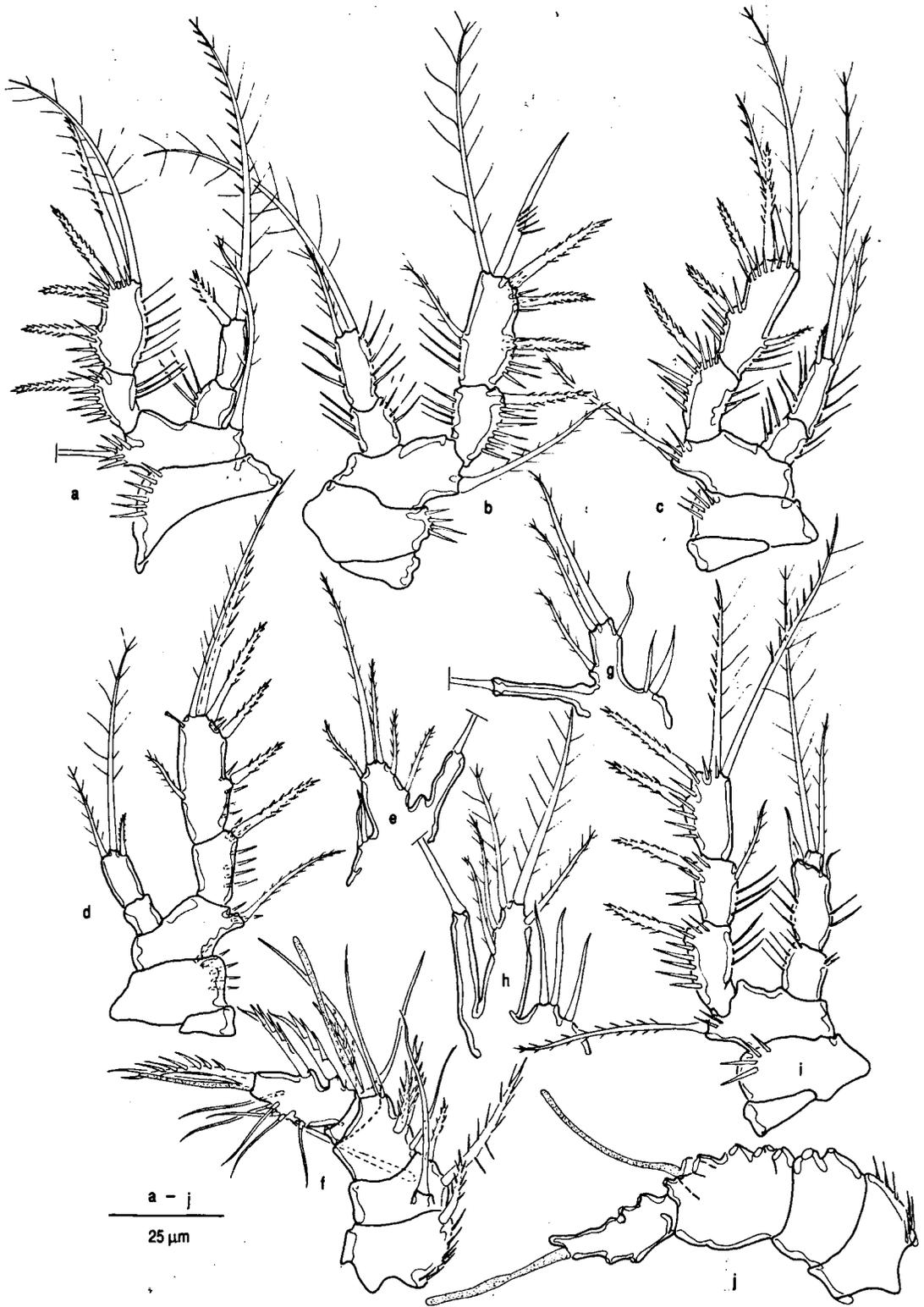


Fig. 15. *Cletodes macrura* n. sp., copepodid IV: a, p1; b, P2; e, P5; f, P4; antennule; copepodid V: g, male P5; h, female P5; i, male P3; j, male antennule.

Table V: Chaetotaxy of *Cletodes tuberculatus* n. sp.

	P1	P2	P3	P4	P5♀	P5♂
exo	0-0-022	0-0-022	0-0-022	0-1-022	5	4
end	0-011	0-010	0-010	0-010	1	0

7-1 (ZMA Coll. no. Co. 102.867); allotype: one dissected male, mounted on two slides from station PJ 7-1: (ZMA Coll. no. Co.102.868); paratypes: dissected, 7 females (ZMA Coll. no. Co.102.869, M.S.I.); 2 males (M.S.I.); 3 Cop I (COP 3141-3142, 3144); 1 Cop II (COP 3143); 1 Cop III (COP 3138); 1 Cop IV (COP 3140); 1 Cop V (COP 3139); preserved: 31 females, 13 males, 10 Cop I, 10 Cop II, 7 Cop III, 1 Cop IV (female), 2 Cop V (females) (ZMA Coll. no. Co.102.870-102.871, COP 3145-3156 and M.S.I.)

Etymology. — The specific name refers to the small but distinct humps (Latin, *tuberculum*) along the posterior margins of the segments, bearing the sensillae.

#### Description.

##### Adults

Female: habitus (Fig. 16 a, b) cylindrical with largest width near the posterior margin of the cephalothorax (100 µm). Length, including rostrum and furcal rami, 440 µm. Length of cephalothorax about one fifth of body-length. Cephalothorax slightly constricted in the posterior half. Anterior part of cephalothorax strongly tapering towards the rostrum. Thoracic and abdominal segments with curved lateral margins. Pleural regions strongly convex in the thoracic segments, and posterolateral extended in the first and second abdominal segments. Sensillae on posterior margins of the segments arising from a small cylindrical tubercle.

Integument of all somites strongly sclerotized, forming distinct curved internal bands and rigid edges. Integument of cephalothorax forming a dense pattern of irregular pits (see Fig. 16 a), interrupted by longitudinal smooth bands. Posterior margins of cephalothorax and thoracic segments

smooth, except for a few fragile hairs along the posterolateral margin of Th 5. Posterodorsal margins of the genital and abdominal segments smooth, lateral margins spinulose or hairy. Ventrally, posterior margin of genital and second abdominal segments set with spinules. Anal operculum slightly convex and furnished with teeth along the edges.

Rostrum (Fig. 17 g) strongly tapering anteriorly and directed downwards. Rostral tip not protruded. Dorsal integument reticulated.

Furcal rami slightly curved, tapering posteriorly and about 5.5 times as long as wide. Inner proximal edge forming a blunt extension. Dorsal seta, articulating on two basal parts, and two lateral setae arising in the anterior third of the rami. Third lateral seta implanted in the posterior third. Outer and inner principal setae fused near their basis. Inner apical seta small.

Antennule (Fig. 17 b) five-segmented, furnished with rigid spine-like setae. Aesthetascs implanted on the third and ultimate segment. Integument of the segments smooth except for some rows of sharp spinules on the first and second one.

Antenna (Fig. 17 l) with allobasis and a one-segmented cylindrical exopodite, bearing a single long and feathered seta. Inner seta of the allobasis arising in the apical half of the segment. Endopodal segment furnished with strong spinules and having three lateral and six apical setae/spines in all.

Mandible (Fig. 17 i) with slender gnathobasis, bearing three long teeth and a single seta apically. Pars molaris situated in the outer half of the gnathobasis. Mandibular palp having two apical and two lateral setae. Rami obsolete.

Maxillulae (Fig. 17 j) with four strong spines and two setae on the arthrite. Coxa with two setae. Basis cylindrical, bearing eight lateral

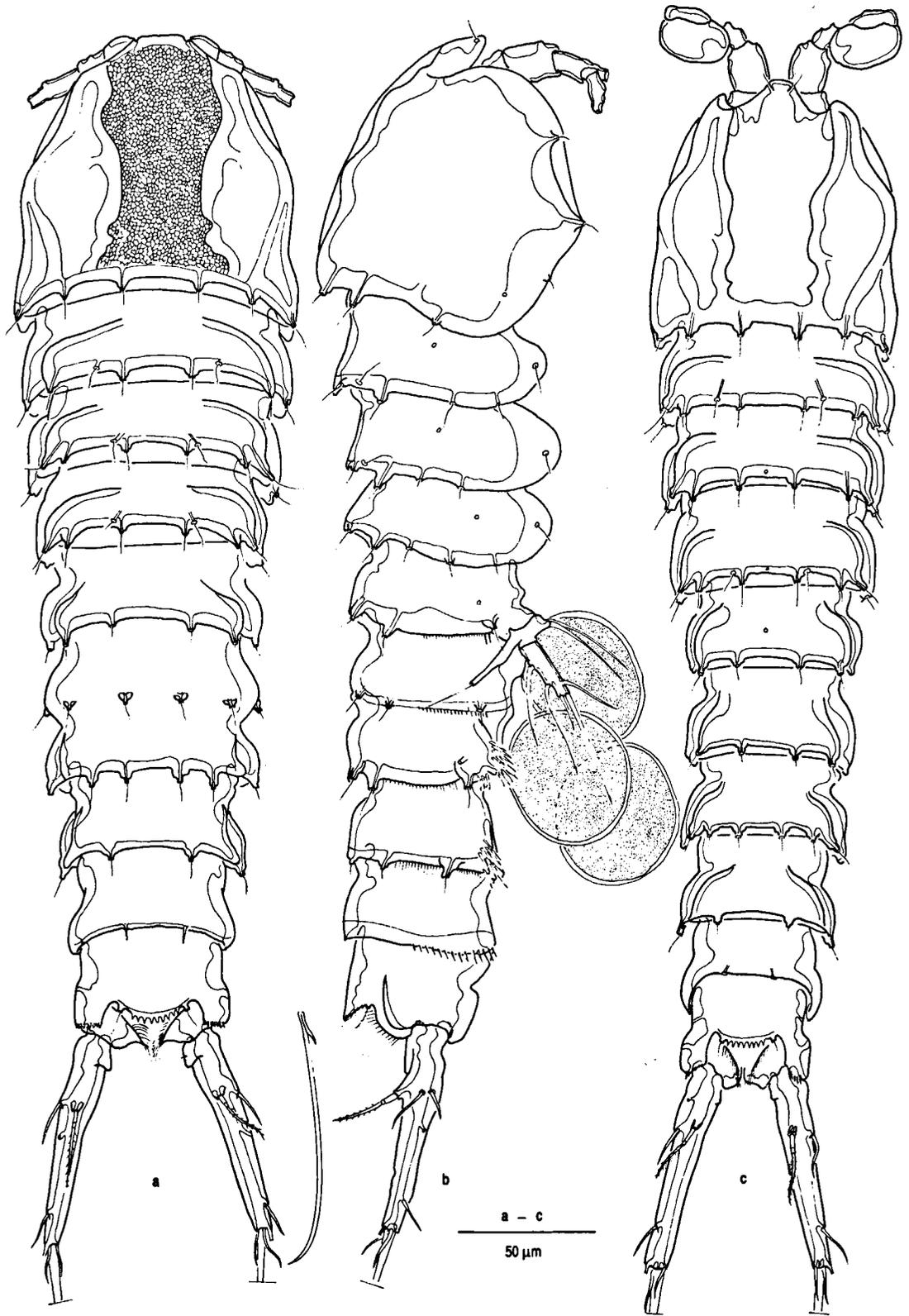


Fig. 16. *Cletodes tuberculatus* n. sp.: a, female habitus, dorsal; b, female habitus, lateral; male habitus, dorsal.

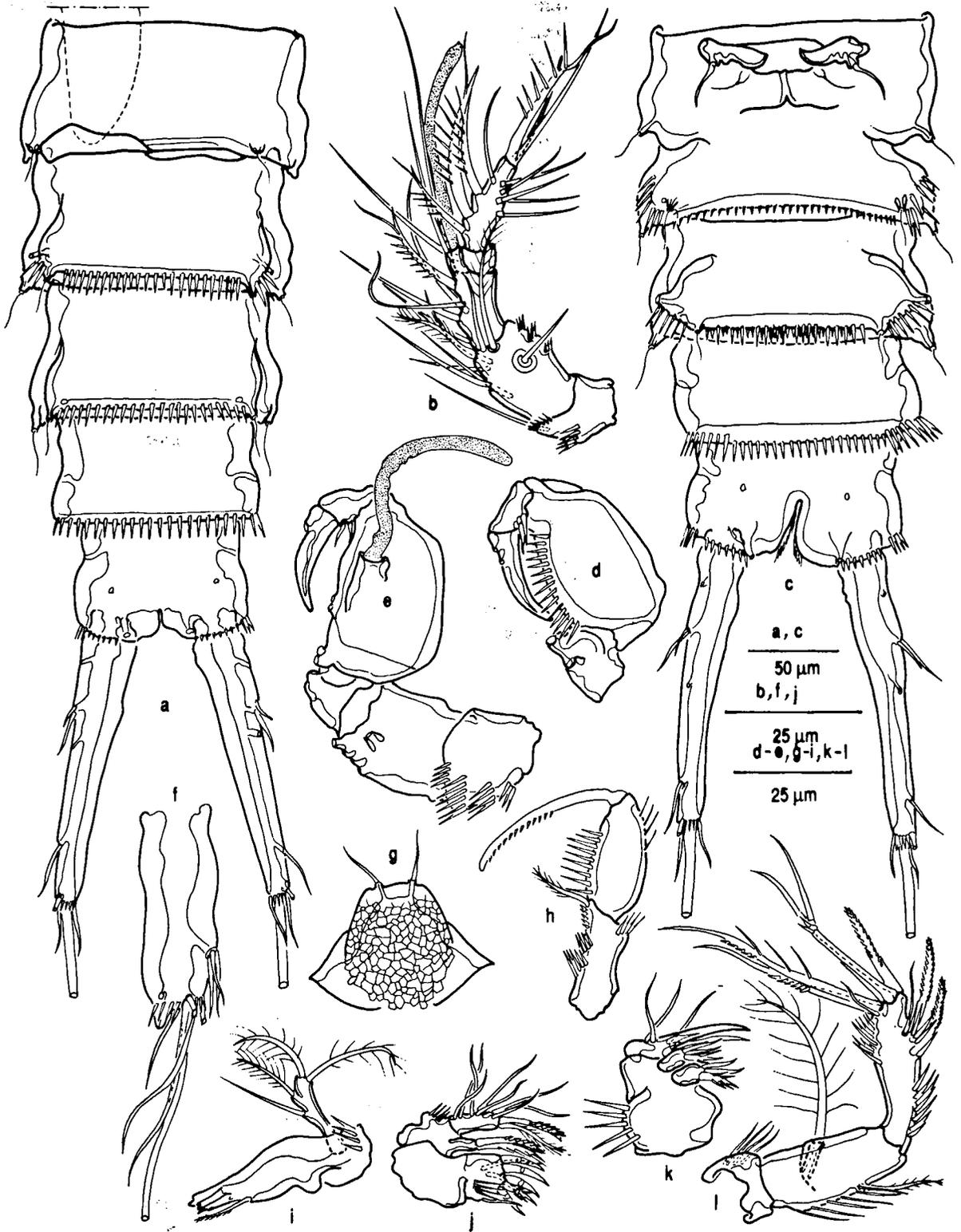


Fig. 17. *Clotodes tuberculatus* n. sp.: a, male abdomen, ventral view; b, female antennule; c, female abdomen, ventral view; d, ultimate segments of male antennule, dorsal; e, male antennule; f, abberant furcal ramus; g, rostrum, dorsal; h, maxilliped; i, mandible; j, maxillule; k, maxilla; l, antenna.

setae, representing the vestigial rami and two apical setae.

Maxilla (Fig. 17 k) small, only slightly higher than the preceding appendage. Two endites, both with three setae. Basis hook-shaped, furnished with two lateral and two apical setae.

Maxilliped (Fig. 17 h) with a single seta and furnished with several rows of spinules. Inner margin of endopodal segment and claw armed.

P1-P4 (Fig. 18 a, b, c, d, respectively) bases slightly extended externally, bearing a feathered outer seta. P1 basis with an inner seta, reaching almost to the apical end of the endopodite. Exopodites three-segmented, endopodites two-segmented. First endopodal small, at the most as high as wide. Second endopodal segments long and slender, all densely clothed with long spinules. Chaetotaxy of the legs in Table V.

P5 (Fig. 18 f) without protruded endopodal lobe. Exopodite 3.5 times as long as wide and bearing five setae. Baseoendopodite with a long outer cylindrical extension bearing the outer setae. Endopodite represented as a single feathered seta.

Male: habitus (Fig. 16 c) as in the female but more tapering posteriad and without fused genital segments. Length as in the female. Posteroventral margins of the abdominal segments set with long spinules.

Antennule (Fig. 17 e) six-segmented, subchirocer. Aesthetasc implanted on the fourth segment. Ultimate segment prolonged, forming a long curved claw. Ventrally directed surface of the fourth segment smooth but dorsally directed surface armed with a comb of rigid spinules (Fig. 17 d).

P3 (Fig. 18 e) with a three-segmented endopodite, showing a distinct apophysis on the inner distal edge of the median segment. Protodite and exopodite as in the female.

P5 (Fig. 18 g) without endopodal seta. Exopodite slightly longer than double the width and having four setae.

P6 (Fig. 17 a) strongly asymmetrical. Right leg irregularly ovate, left leg only presented by a chitinized strip. Both legs without setae.

Variability. — Some specimens were found

showing a misbuilt furcal ramus. As illustrated in Fig. 17 f, such rami are short, only three times as long as wide, and having much longer apical setae.

## Copepodids

Remarks: The body facies of the copepodids resemble closely that of the adult, except however for the number of body segments. As such, they are illustrated here only for the first and second copepodids.

### Copepodid I

Body length (Fig. 19 a) 175  $\mu\text{m}$ . Body composed of five segments. Largest width near the posterior end of the cephalothorax. Length of the head almost one third of the entire body length. Integument clothed with minute spinules. Ventral surface of the anal segment with a transversal row of long spinules. Anal segment smooth, slightly convex.

Furcal rami with an adult appearance but with two dorsal setae (one in the proximal half and one near the distal edge) and a long outer principal seta. Inner apical seta absent.

Antennule (Fig. 19 k) three-segmented with aesthetascs on the second and third segments. Antenna (Fig. 19 c) as in the adult but with a larger exopodite, bearing two setae. Mouthparts as in the adults.

P1-P2 (Fig. 19 d, e, respectively) with differentiated protopodites and one-segmented rami. Chaetotaxy in Table VI. Inner seta of the P1 basis absent.

P3 (Fig. 19 b) represented as a distinct socle bearing three setae.

### Copepodid II

Habitus (Fig. 19 f) resembling closely the preceding stage but composed of six segments. Anal operculum set with a transversal row of spinules. Length 215  $\mu\text{m}$ .

Furcal rami as in the adult, having one dorsal, three lateral and three apical ones.

Antennule (Fig. 19 l) four-segmented. Aesthetascs implanted on the second and fourth

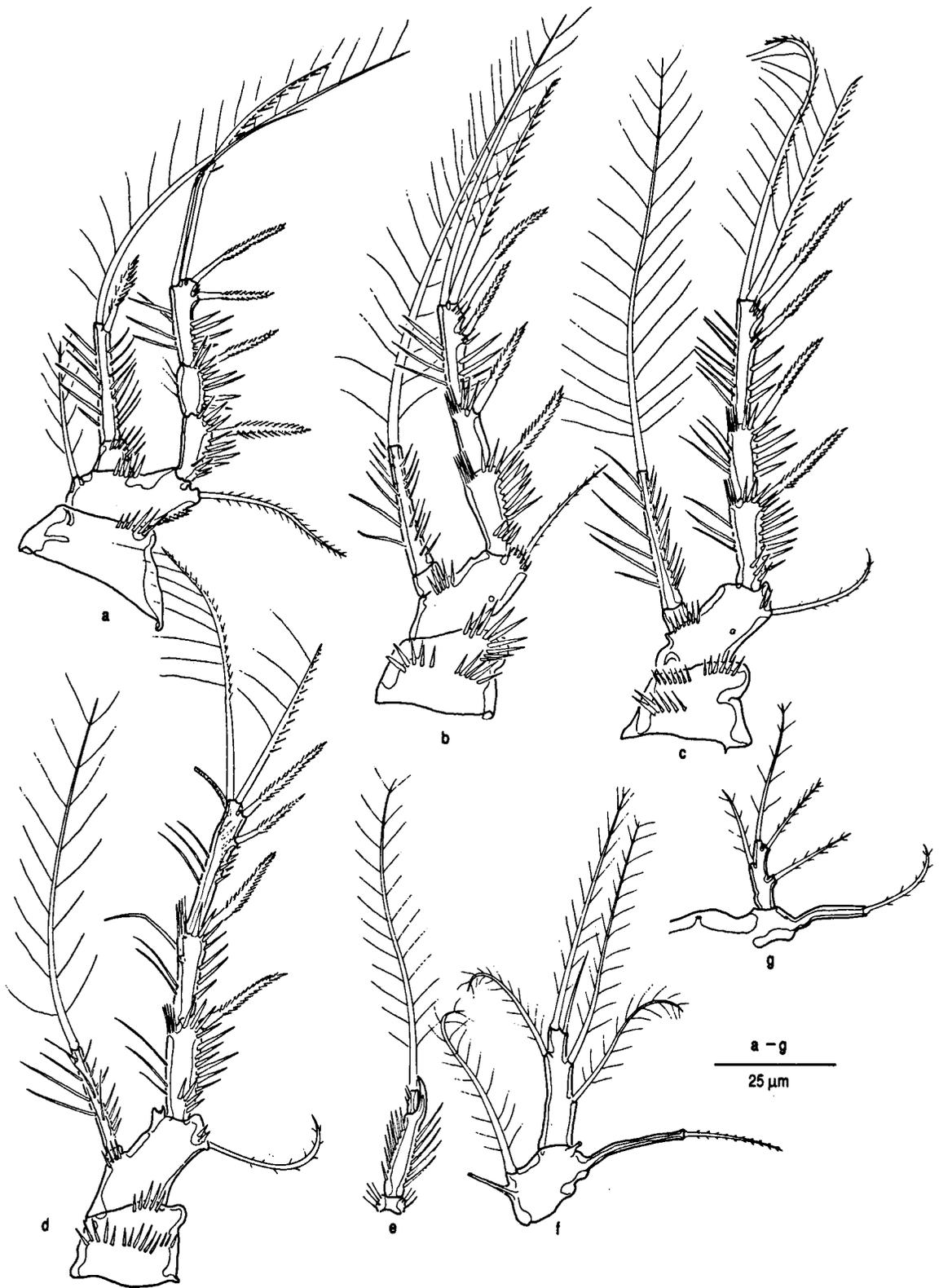


Fig. 18. *Cletodes tuberculatus* n. sp.: a, P1; b, P2; c, P3 (female); d, P4; e, endopodite P3 (male); f, female P5; g, male P5.

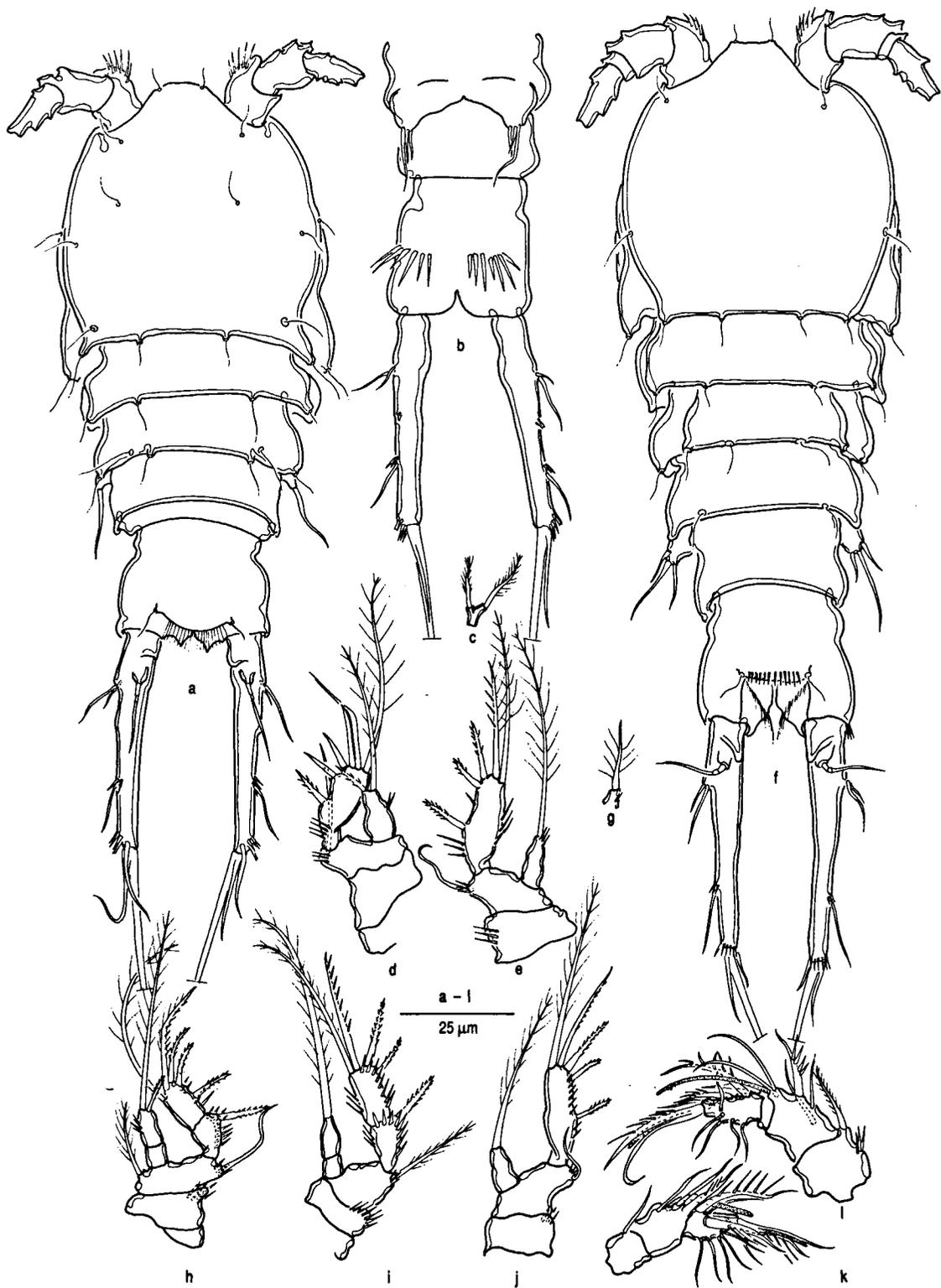


Fig. 19. *Cletodes tuberculatus* n. sp., copepodid I: a, habitus, dorsal; b, third, fourth and anal segment, ventral; c, exopodite of the antenna; d, P1; e, P2; copepodid II: f, habitus, dorsal; g, exopodite of the antenna; h, P1; i, P2; j, P3; k, antennule of Cop I; l, antennule of Cop II.

Tabel VI: Chaetotaxy of the copepodids of *Cletodes tuberculatus* n. sp.

legs	Cop I	Cop II	Cop III	Cop IV	Cop V
P1 exo	0,1I,IV	0,I-0,1I,III	0,I-0,1I,III	0,I-0,1I,III	0,I-0,I-0,1I,II
P1 end	0,1,I	0,0-0,1,I	0,0-0,1,I	0,0-0,1,I	0,0-0,1,I
P2 exo	0,1I,III	0,I-0,1I,II	0,I-0,1I,III	0,I-0,1I,III	0,I-0,I-0,1I,II
P2 end	0,1,0	0,0-0,1,0	0,0-0,1,0	0,0-0,1,0	0,0-0,1,0
P3 exo	3	0,1I,III	0,I-0,1I,II	0,I-0,1I,III	0,I-0,I-0,1I,II
P3 end		0,1,0	0,0-0,1,0	0,0-0,1,0	0,0-0,1,0
P4 exo	-	3	0,1I,III	0,I-0,1I,III	0,1-0,I-0,1I,II
P4 end			0,1,0	0,0-0,1,0	0,0-0,1,0
P5 exo	-	-	3	3	5
P5 bas				1	1
P6	-	-	-	-	-

segments. Antenna (Fig. 19 g) with a small exopodal segment, having only one seta.

P1-P2 (Fig. 19 h, i, respectively) with two-segmented rami. Basis of P1 with an inner seta, as long as the entire endopodite.

P3 (Fig. 19 j) with distinct protopodal components and one-segmented rami. Chaetotaxy of the legs in Tabel VI.

P4 as the P3 in the copepodid II.

#### Copepodid III

Habitus as in the preceding stage but with seven segments. Length 260  $\mu\text{m}$ . Antennule (Fig. 20 g) four-segmented as in the preceding stage but with a longer second segment and more setae on the latter.

P1-P3 (Fig. 20 a, b, c, respectively) with two-segmented rami. P4 (Fig. 20 d) with one-segmented rami.

P5 (Fig. 20 h) present, represented as a small socle with three setae.

#### Copepodid IV (female)

Habitus resembling closely the adult facies, with eight segments. Length 300  $\mu\text{m}$ . Antennule (Fig. 20 k) five-segmented with aesthetascs on the third and fifth segments. General appearance as in the adult but with smaller segments.

P1-P4 having two-segmented rami. P2-P4 with the same morphology (Fig. 20 e, f). Chaetotaxy in Table VI. P5 (Fig. 20 i) with a

distinct exopodal lobe, bearing three setae. Baseoendopodite with an outer seta implanted on a long cylindrical extension and with one inner seta.

P6 not present.

Male copepodid IV not found.

#### Copepodid V (female)

Habitus as in the adult but with only nine segments. Length 350  $\mu\text{m}$ . Antennule, mouthparts, as well as legs 1-4, as in the adult. The latter with three segmented exopodites and two-segmented endopodites. Chaetotaxy in Table VI.

P5 (Fig. 20 k) as in the copepodid IV, somewhat larger and bearing five exopodal setae and a single inner baseoendopodal one.

P6 not present.

Male copepodid V not found.

*Discussion.* — It is apparent that *Cl. tuberculatus* n. sp. is most closely related to *Cl. smirnovi* Bodin, 1970 and *C. reductus* Moore, 1978. These three species share a common chaetotaxy of the exopodites with only one inner seta on the median exopodal segment of the P4. *Cl. tuberculatus* n. sp. differs from its congeners by the more reduced chaetotaxy of the endopodite P2, bearing only one seta and the shape of the furcal rami, showing a distinct process on the inner proximal edge. Furthermore, the here described species exhibits considerably smaller

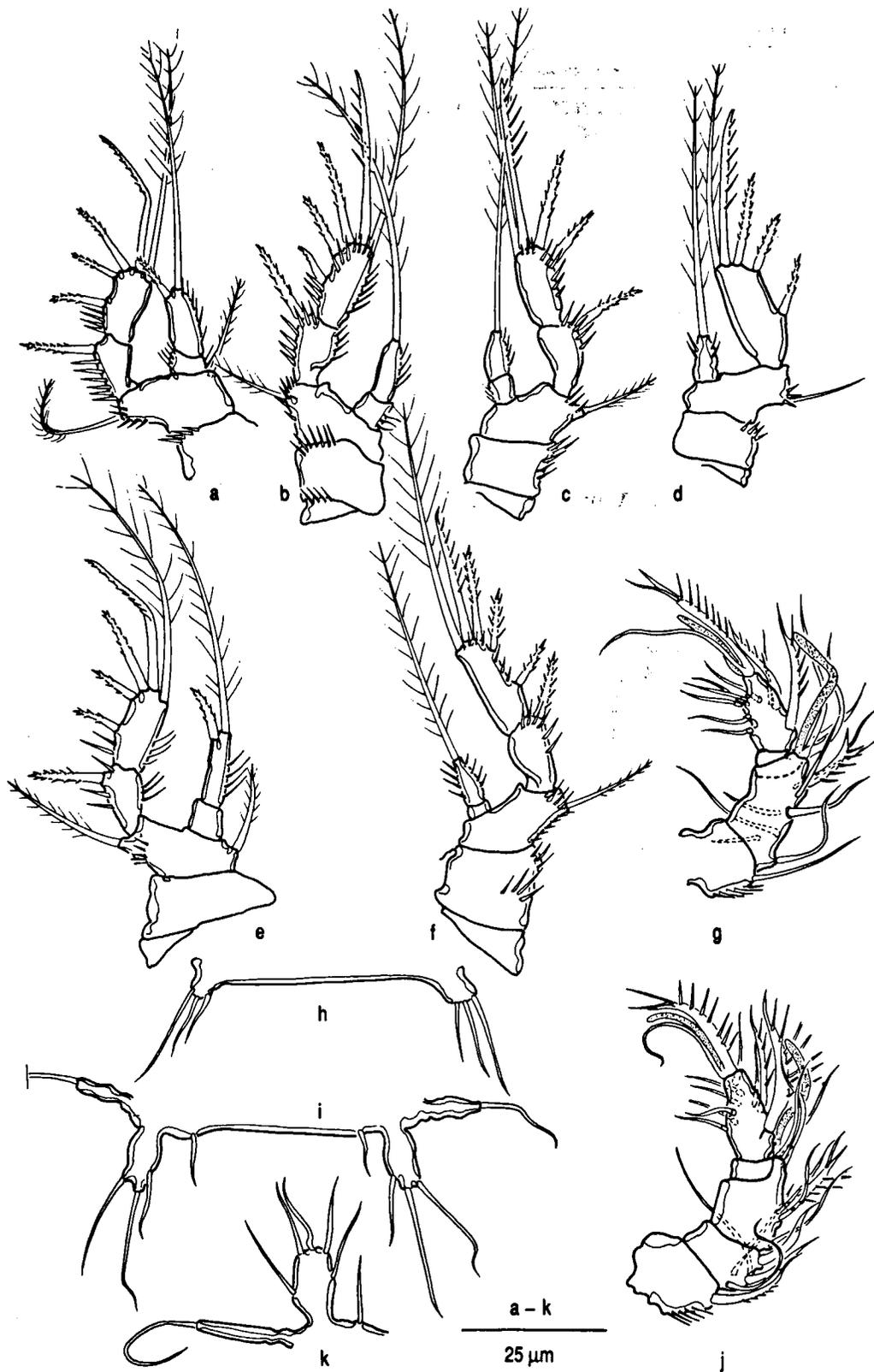


Fig. 20. *Cletodes tuberculatus* n. sp., copepodid III: a, P1; b, P2; c, P3; d, P4; copepodid IV: e, P1; f, P4; copepodid III: g, antennule; h, P5; copepodid IV: i, P5; j, antennule; copepodid V: k, P5.

endopodites in P1 and P2. In *Cl. reductus* and *Cl. smirnovi*, the endopodal ramus of P1 reaches almost to the distal margin of the exopodite, whereas the endopodite of the P2 is as long as the two proximal exopodal segments. In *Cl. tuberculatus* n. sp. the endopodites reach only halfway the third exopodal segment in P1 and only halfway the second exopodal segment in P2.

Males of these closely related species are distinguishable mainly by the chaetotaxy and shape of the P5. Whereas *Cl. reductus* and *Cl. smirnovi* bear three setae on the rather short exopodal ramus, *Cl. tuberculatus* n. sp. bears a much longer exopodite furnished with four feathered setae.

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